

THE SCIENTIFIC AND LITERARY REVIEW,

AND RECORD OF PROGRESS IN ARTS, INDUSTRY, AND MANUFACTURES,

INCORPORATING THE

Journal of the Inventors' Institute.

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THE INVENTORS' INSTITUTE, 4, ST. MARTIN'S PLACE, TRAFALGAR SQUARE.

Chairman of the Council—SIR ANTONIO BRADY.
THE various efforts which have been made, and the numerous influences now at work to injure, if not to destroy, Patent Rights; the inefficiency of the many well intended, but ill considered, schemes of Patent Law Reform which have from time to time been suggested, and the tendency of which has generally been to prejudice the Inventor, without advantage to the Public; together with the proceedings so essentially involving the interests of inventors which have already taken place in Parliament, show the necessity of an immediate and active co-operation on the part of those interested in Inventions and in Patent Property, and that an Association for the Protection and Defence of Patent Rights is urgently needed. This Institute has, therefore, been established for the purpose of uniting and organizing the influence of Inventors, Patentees and others. Its objects are:—

- 1st. To protect Inventors' interests and defend the privilege of obtaining her Majesty's Letters Patent.
- 2nd. To promote improvements in the Patent Laws.
- 3rd. To facilitate the diffusion of information with reference to Inventions and other subjects beneficial to Inventors and Patentees.

The qualification for Annual Members of the Institute is a yearly Subscription of One Guinea, and for Life Members a single payment of Ten Guineas.

Persons desirous of becoming members are requested to forward their names and addresses to the Secretary.

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APPLICATIONS FOR LETTERS PATENT.

* In this list (Com.) means Invention communicated from abroad.

Further information, as to the progress of these Patents by Notice to Proceed, Sealing, and Specifying, can be obtained at the Office, 21, Cockspur-street, Charing Cross.

On April 1st.—1194 to 1207.—R. Smellie and J. Vance. Self-acting railway signal apparatus.—W. Beecroft. Construction of moulds for moulding metals, and the combination of materials for the same.—R. J. Gay. Manufacture of artificial fuels.—T. H. Sharpe. Apparatus for the moulding of clay and other plastic substances.—W. Morrison and J. Mitchell. Self-acting mules.—F. L. Rovedino. Manufacture of faggots of fire-lighters.—W. Anderson. System of checking tramway-car and other fares and payments.—Hon. R. Flower. New or improved fuel.—F. Johnston and R. T. Cotton. Looms for weaving.—W. Mitchell. Utilising the waste heat of smiths' fires for the purpose of economising fuel.—Rev. G. H. Forbes. Manufacture of cement, plaster, artificial stone, and other similar materials, also applicable for use as fuel.—A. M. Clark. Apparatus for raising and measuring acids and other liquids (com. by F. Nichols).—N. D. Spartali. Fuel.—H. Hill. Grates and fire-places.

On April 2nd.—1208 to 1227.—J. F. E. Chamas, L. Bouju, and M. R. Bouju. New textile obtained from the plant known as the "hibiscus esculentum," or "gombo."—W. Murdoch. Regulating the speed of motive-power engines worked by steam or other fluid.—J. Caldbeck. Preventing fraudulent appropriation of money by party or parties entrusted with the taking of fares of passengers on tramway cars or other conveyances.—B. Tydeman. Fitting and hanging of window sashes and making frames for sashes.—J. Young. Feeding steam boiler furnaces with fuel.—W. Palliser. Boots and shoes.—W. H. Gold. Reservoir penholder.—R. Sim, M.D., and A. Morgan. Varnish.—D. K. Clark, C.E. Machinery and apparatus for the manufacture of peat fuel and peat charcoal.—J. Watson. Apparatus for heating conservatories, greenhouses, and other horticultural structures.—W. M. Brown. Machines for cutting files (com. by A. Weed).—T. Silver. Air-rarefying lamp burner.—J. Newall. Producing motive force.—J. H. Johnson. Manufacture of cast steel and other metals, and in the making of castings of the same (com. by J. A. Holmes).—J. H. Johnson. Preparation of ozone, and in the application of the same to various useful purposes (com. by P. J. David, and J. Fichet).—W. R. Lake. Life-preserving mattress (com. by H. B. Mountain).—H. Smith. Apparatus for ventilating mill-stones, and machinery for separating the fine meal from the currents of air passing form mill-stones.—H. Holland. Manufacture of runners and top notches for umbrellas and parasols.—

A. M. Clark. Falling carriage heads (com. by S. Berry).—A. M. Clark. Machinery for cleaning and separating ores (com. by J. H. Hillman).

On April 3rd.—1228 to 1246.—W. Clark. Apparatus for clipping or shearing horses and other animals.—L. M. E. Péan. Spinning tops, producing various sounds whilst in motion.—J. W. Grover. Washers for screw bolts.—H. Simon, C.E. Wire tramways (com. by C. Memicke).—A. J. Maher. Appliances for hooking or securing, and for unhooking or unloosing horses from tramway or other cars or carriages while the same are in motion.—W. M. Brown. Improved granulating machine (com. by C. H. Hersey F. C. Hersey, and R. B. Gray.—(Complete specification).—J. H. Johnson. Steam engines (com. by W. G. Ulery.—(Complete specification).—T. E. Wilson. Machinery for screening and washing sand, coal, and other materials.—J. Maybery. Preparing iron for the manufacture of tin-plates or black-plates.—J. Howard and E. T. Bousfield. Steam boilers.—A. V. Newton. Improved shuttle motion for looms (com. by C. I. Kane).—G. W. Crawshaw. Open fire-places.—J. M. Cory. New or improved instrument for drawing in perspective.—A. M. Clark. Steam and hydraulic presses (com. by J. F. Taylor).—J. Pullman, junior, and J. R. Edmonds. Staking and grounding leather.—J. Blick. Railway breaks.—A. Thomas. Means of and appliances for relieving gas retorts from pressure, and for hermetically sealing the joints of hydraulic and other mains of gas works.—J. C. A. H. Wolf-gram. Preparing peat for use as fuel.—W. M. Brown. Machines for verifying the relative positions of the rails of a railway or a tramway (com. by Camozzi and Schlösser).

On April 4th.—1247 to 1266.—J. W. Hurst. Life rafts.—H. B. James, C.E. Seats of row boats.—J. S. Crosland. Steam boilers or generators.—G. Haseltine. Elevating apparatus (com. (Complete specification).—J. R. Harper. Gas-lamp blow-pipe apparatus, part of such improvements being applicable to other oil and spirit lamps.—W. L. Wise. Rotary pumps (com. by W. Tasker. Elevators or machines for elevating hay, corn, straw, and other agricultural produce.—C. N. Artsayooloff. Apparatus for effecting the releasing of ships' boats or other weights (com. by J. West. Improved method of manufacturing gas and for the apparatus employed therewith.—T. G. Woodley. Joints for joining metallic pipes and tubes.—W. M. Adams, B.A. Instrument for exhibiting the motion and position of the heavenly bodies relatively to any point on the surface of the earth, and for embodying the various conceptions necessary for nautical astronomy.—A. Jobsen. Mode of utilising the waste heat of coke ovens, and in the construction of them.—W. Dawes. Fasteners for sashes or casements and other similar purposes.—J. W. Melling. Safety and relief valves.—R. Stone. Composition to be used for making, laying, or surfacing roadways, footways, and other similar surfaces, rendering them safe and slipless.—W.



Wood. Machinery or apparatus for finishing thread.—G. Pashley. Valves.—W. Black. Apparatus for clearing rails of railways and tramways.—S. Bonner. Kilns for burning bricks, tiles, drain pipes, lime, earthenware, and other analogous articles.—F. B. Taylor. Sewing machines.

On April 5th.—1267 to 1273.—S. Davey and J. Watson, C.E. Apparatus and instruments for firing blasting charges.—W. M. Scott. Breech-loading small arms.—C. Willis. Fuel economisers, or apparatus for heating the feed water of steam generators, or superheating steam.—L. Weber. Galvanic batteries. (Complete specification).—H. Hobson. Method of, and apparatus for, ascertaining the temperature of hot blast or of heated gases, partly applicable to pyrometers otherwise used.—S. Mendel. Woven fabrics.—J. B. Walker. A new or improved fuel.

On April 7th.—1274 to 1283.—A. W. Ellis. Treatment of substances and liquors containing ammonia and cyanogen, and obtaining products therefrom.—A. Andrews. Elevators for stacking hay, corn, and other agricultural produce.—J. G. Hey and R. Sugden. Means or apparatus for treating and utilising gas tar for heating purposes.—T. Fearn. Electro-deposition of tin.—J. Henderson. Construction of steam ships and other ships or vessels.—G. Bear. Manufacture of cigars, and apparatus to be used for this purpose.—E. Edwards. Apparatus for drilling holes in rocks and other hard substances.—G. Leach. Construction and arrangement of winding gear, or apparatus for hauling, lifting, and winding.—W. Barton. Fire-places.—W. R. Lake. Sewing machines (com).

On April 8th.—1284 to 1302.—H. H. Bennett. Seats and driving boxes of carriages and other vehicles.—A. W. Ellis. Utilization of waste products of ammoniacal liquor.—C. Brakell. Improvements in the drying of peat and its manufacture or preparation into peat fuel, and the application of the said fuel to the manufacture of iron from the ore, some parts of the said improvements being also applicable for drying other materials or substances, and apparatus connected therewith.—T. F. Rowland. Apparatus for supplying and measuring coal, and charging and emptying gas retorts. (Complete specification).—T. Whitwell. Fire-places and stoves. (Complete specification).—J. E. Wilson, C.E. Propelling vessels. J. E. Wilson, C.E. Machinery for cutting wood.—C. E. Curtis. Carriages with front bowed or other shaped front lights.—G. Gibbons and E. Paget. Means of, and apparatus for, collecting and removing hay and other cut field crops.—J. H. Johnson. Metallic heels for boots and shoes, and the mode of attaching the same (com).—W. Bates. Securing the lids or covers of tea-pots, jugs, and other like vessels.—W. Carron. Fastenings for brooches, sleeve links, and other articles of jewellery, ornament, and dress.—A. Keen. Machinery for the manufacture of screws.—F. E. Duckham and G. R. Birt. Grain and other elevators.—W. Shaw. Mechanical construction of printing types, and the tools employed for correcting typical errors. (Complete specification).—W. E. Gedge. Process of removing grease in the manufacture of tin-plates or terce-plates, and improved apparatus in connection therewith (com).—W. E. Gedge. Manufacture of parasols and umbrellas (com).—T. C. Brown and G. A. Biddell. Steam-engines and boilers.—H. Larkin and W. White. Production of iron and steel.

On April 9th.—1303 to 1319.—G. M. Hammer. Construction of school furniture.—A. M. Silber. Improved burner.—A. S. Pratt. Means of ventilation, more particularly adapted to ships' holds, and the apparatus employed therefor.—G. Arenal. Construction of timber rods for pumping engines for mines and other works, also applicable for shears, girders, ships' keels, or for other similar purposes.—W. Green. Automatic couplings for railway and other carriages, also the formation of spikes for permanent way.—J. H. Johnson. Mode of, and apparatus for, removing sand banks at the mouths of harbours and other places (com).—W. D. Mann. Construction of railway carriages and fittings.—T. J. Smith.—Steam boilers, and the construction of fire-boxes and water-tubes for these and other steam boilers (com).—F. B. Houghton. Special process or method of operating upon straw, esparto, flax, and other similar fibrous materials for the manufacture of pulp for paper.—J. Brough. Apparatus for saving life and

property at sea, which improvements are also applicable to the landing of mails and passengers.—L. Goddu. Certain new and useful improvements in that class of naval vessels termed Monitors. (Complete specification).—G. Twigg. Shearing and clipping apparatus.—J. Davey. Steam generators.—J. Chisholm. Machines for doubling known as "twiners."—C. H. Sieber. Mode of, and apparatus for, removing the incrustation from steam boilers.—A. R. Ecroyd and J. Wass. Furnaces for steam-boilers and other purposes.—G. Alsing, C.E. Treatment of night soil, of sewage deposits, and other similar moist manurial matters.

STEAM LOCOMOTION ON COMMON ROADS.

By JOHN HEAD, Soc. INST. C.E.
(Continued from our Last.)

LOCOMOTIVES FOR USE IN AGRICULTURAL OPERATIONS, STEAM PLOUGHING, &c.

Although several excellent farm locomotives were in use, there was not much novelty in the construction of these engines, and they really consisted of a portable engine, fitted with various methods of transmitting the power from the crank shaft to the road wheels.

The chief difficulty which had beset engineers in the construction of this class of machinery, had been the impossibility of theoretically calculating the varied strains to which the component parts of such an engine were subjected, in the same manner as in a railway locomotive, and the principal proportions of the engines illustrated in the paper had been the result of a long and careful experience and laborious experiment.

The two first self-moving or traction engines were exhibited by Messrs. Ransome; the first in 1846, at the Royal Agricultural Society's Meeting, at Bristol, and the second in 1849, at Norwich; but as the idea of moving the engines by steam did not find favour with farmers, little was done until eight or nine years after, when Mr. Burrell designed his agricultural locomotive, in which the transmission between the engine and driving wheels was effected by means of a pitched chain, and with several improvements he had adhered to this principle to the present time. One feature in his engine was worthy of notice. The hinder part of the engine was mounted upon volute springs, set at an angle, so as not to interfere with the movement of the chains, and it has been found in practice that, the use of springs diminished to a great extent the wear and tear of the engine.

Mr. Aveling exhibited his first engine at the Royal Agricultural Society's Meeting at Canterbury, in 1860. It also worked with a pitched chain, and was steered by means of a fifth wheel, in the form of a disc, placed at the end of a wrought frame, fixed to the fore axle. The boiler was of the usual locomotive type, with one cylinder placed on the top, and the crank shaft was connected with the driving wheels by means of malleable iron gearing. An ingenious arrangement for facilitating the turning of corners, called a "compensating gear" or "Jack in the box," was fixed on the driving axle, thus avoiding the necessity of clutches for throwing the driving wheels in and out of gear when going round sharp corners.

Messrs. Clayton and Shuttleworth, and Messrs. John Fowler and Co., also manufactured agricultural engines, equal in point of workmanship and design to those already described, but differing somewhat in their general arrangement and details.

STEAM PLOUGHING ENGINES.

Messrs. Fowler's steam ploughing engines being constructed so as to move themselves on the road, and haul not only the implements which form part of the tackle, but also waggons, from one part of the farm to another, came within the range of locomotives on common roads.

The "double-engine system" of steam ploughing, in which each engine was placed on an opposite headland of the field, moving themselves at intervals, and alternately

winding up or paying out the steel rope which hauled the implements to and fro, had been found the most economical in the variety of trials to which steam ploughs had been subjected for several years, and the author had selected the 12 h.p. engine of Messrs. Jno. Fowler and Co., of Leeds, as the most perfect specimen of a steam-ploughing engine yet designed.

The engines for steam ploughing were generally of more power, and, consequently, heavier than the ordinary farm engine, on account of the greater amount of power which was necessary to till the land, than to perform any other agricultural operation.

The following data respecting the cost of power in steam ploughing were deduced by the judges at Wolverhampton, in 1871, from the various experiments and trials carried out at that time:—

The average consumption of—

Coal = 161 lbs. per acre.

Water = 115 gals. per acre.

Oil and tallow = 5.1 ozs. per acre.

Water per lb. of coal = 7.2 lbs.

Coal, per mean indicated h.p. per hour 7.1 lbs.

The average weight of earth moved per lb. of coal = 9.3 tons.

ROAD LOCOMOTIVES FOR MILITARY PURPOSES.

So little experience has been gained in the employment of road locomotives for the purpose of hauling heavy guns, siege trains, and transport waggons in time of actual war, that no reliable data existed upon which to form a practical opinion respecting the advantages of their use in lieu of horses for the transport of war material. It had, however, for some time been the opinion of some of our most experienced engineer and artillery officers, that steam power might be advantageously employed as an important auxiliary to an army on the march.

A road locomotive could be used as a fixed engine, to saw wood or pump water. It could be employed for transporting guns or other war material, and was specially useful in the neighbourhood of a fortress, when the town formed the apex of the triangle, and the railway the two sides, which, however, could not be used by the besieging army. All stores and provisions required to be transported beyond the fortress must go along a line of road forming the base of this triangle, and the traction engine, with its train, would form a much more rapid means of communication between the two railway stations, than ordinary carts or waggons drawn by horses or bullocks. The Prussians, at Metz, constructed a line 20 kilometres long, to skirt the fortress of the city, but it was not required, as the garrison capitulated before its completion.

In addition to the above uses, the engine could be so constructed that flanged railway wheels might be substituted for the ordinary rigid wheels used on common roads, and it would then serve as a light railway locomotive in case the enemy destroyed or secured all the rolling stock on the existing railways.

A traction-engine for military purposes should be made as light as possible, and constructed, almost entirely, of wrought iron or steel, in order to diminish the chances of breakage. Its weight should not exceed 5 tons, with about 72 cwt. on the driving wheels in order that it might be able to pass over the pontoons as at present constructed, and also over temporary wooden bridges, hastily made to repair the arches in masonry or iron, blown up by the enemy. It should be furnished with a powerful windlass, arranged in such a manner that the engine, after having ascended a hill or traversed a soft road or marsh, could remain stationary, and haul the guns or waggons up the incline or through the bog by means of a steel rope, one end of which would be fastened to the load and the other to the drum, which would be slowly wound up by the engine, thus enabling it to drag heavy loads through difficult places almost inaccessible for horses.

Scientific and Literary Review,
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JOURNAL OF THE INVENTORS' INSTITUTE.

JUNE 1, 1873.

IN MEMORIAM.

AGAIN we appear before the public bearing the symbols of mourning and death. Again we have to deplore a great loss. The hand of death has been uplifted, and this time to strike the fatal blow at one of the staunchest of the friends of the inventors' cause. ROBERT MARSDEN LATHAM, the Secretary of the Inventors' Institute, and one of the founders of it, is amongst us no more—he has passed away to the spirit world—and the only salutation we can now give him is, *Requiescat in Pace*.

We are at a loss to find words to express the deep sense of deprivation we suffer; for the deceased was no ordinary man, and possessed a fertility of thought, and an amount of practical resource, that rendered him a worker whose labours were well-directed and indefatigable. It is true that as a man of science we cannot rank him with our late lamented President, Sir David Brewster, or with Professor McGauley, both of whom pre-deceased him; but as a worker on behalf of the just rights and claims of inventors, he was *nulli secundus*.

It is now a good many years ago since our deceased friend began to direct his thoughts to the position and prospects of the legal and social *status* of the inventors in the United Kingdom, and, taking counsel with such men as Mr. Richardson, Mr. Hume Williams, Mr. Thomas Webster, Captain J. H. Selwyn, R.N., Mr. F. W. Campin, Mr. C. G. Carttar, and others, was led, over ten years ago, to gather together an array of inventive genius whose names are on the roll of its council, and inaugurate the Inventors' Institute, which has now become one of the foremost of our scientific and social institutions.

Mr. Latham's perspicacity led him to see that the inventor's power would be comparatively small, unless supported by the power of the Press, and although striving, and with success, to maintain friendly relations with all public journals, he nevertheless determined that inventors should possess an organ of their own, and as with him the work of the brain and the action of the hand followed so quickly one upon the other as to be almost simultaneous, so the establishment of the SCIENTIFIC REVIEW might be said to be the simple and natural expression of a thought placed before the world in a practical and tangible form. To secure the success of this journal he spared no expense or trouble, seeking for writers amongst men of scientific eminence, whom he assisted with the practical aid of his own intimate knowledge of the wants and wishes of in-

ventors and men of science. The fame of this journal soon became world-wide, for under his guidance it attained the character not merely of a scientific journal, but virtually that of an inventor's intelligencer.

The political aspect of the inventors' question received much attention from Mr. LATHAM, for having been brought into communication with Mr. Thomas Paterson and Mr. George Savage, leading men in the last movement for working-men's exhibitions,—that held in the Agricultural Hall, in the year 1870, he strenuously exerted himself to bring about a co-operation of the working classes with inventors, which led to his obtaining a position in working-men's movements generally that has been regarded by some persons with little favour, but on certain occasions has been found to be very efficacious in obtaining from our Government proper consideration for the question of the interests of inventors as affected by the patent laws.

Technical education, also, was a subject which engaged much of the attention of our deceased friend, and, in conjunction with Mr. F. W. Campin, he did much to advance this important question of the day, which has now become, one may almost say, a fashionable topic.

The movement on behalf of Tribunals of Commerce met with much sympathy and support from Mr. LATHAM, not only as a friend of law reform in general, but also from the consideration that such Tribunals might be advantageously applied to the determination of patent, trade mark, and copyright questions.

In the operations of the Inventors' Institute generally, Mr. LATHAM may be fairly said to have been the central figure, for he was ever ready to counsel and to write in its behalf, and, in fact, he directed, on his death-bed, certain communications to be made with reference to the Patent Laws, to Mr. Hinde Palmer, Q.C., M.P., Mr. J. Howard, M.P., and Mr. Mundella, M.P. But the public career of the deceased was not the only estimable part of his life, for those who enjoyed his private friendship well know that he was a genial companion, ever kindly disposed towards all his associates, in whose memories he will still continue to live.

Mr. LATHAM, who was 38 years of age at the time of his decease, has left a widow and son who have to mourn the loss of an estimable husband and loving father. He was born in Lancashire, and died at his house at Hampstead, on April 29th, having been ill little more than one week. His mortal remains were deposited in the parish cemetery of St. John's, Hampstead, the funeral being attended not only by relatives and personal friends, but by some members of the Council of the Inventors' Institute, and a number of his associates in public life.

Though our loss cannot be easily repaired, yet we need not despair if all the members of the Institute join in heartily forwarding its welfare. Let them consider that "though dead, he speaketh" to them in words of exhortation and entreaty, adjuring them to continue with vigour the great work that he so well begun, carried on, and caused to flourish, and make it to stand firm as a goodly memento of his organising genius and persistent labour.

Reviews.

Principles of Animal Mechanics. By the Rev. SAMUEL HAUGHTON, F.R.S., Fellow of Trinity College, Dublin, M.D. Dubl. D.C.L., Oxon. London: Longmans, Green, and Co. 1873.

THIS is a work of profound scientific research, the nature and object of which cannot be better described than as observations and calculations which the author states have occupied his leisure hours during the past ten years; and are now offered to the public, with the view of showing the mutual advantages obtainable by anatomists and geometers from a combination of the sciences which they cultivate. Anatomists will gain by the increased precision which numerical statements must give to their observations, and geometers will find in anatomy a new field of problems opened out to their investigation; and, he adds,—I may be allowed to call attention, from this point of view, to the problem of the equilibrium of an elliptical muscular dome, and to the use which I have made of the hyperboloid of one sheet, of Ptolemy's Theorem, and of some curves of the third order. In the course of my investigations, I have met with numerous instances, in the muscular mechanism of the vertebrate animals, of the application of the principle of least action in nature; by which I mean that the work to be done is effected by means of the existing arrangement of the muscles, bones, and joints, with a less expenditure of force than would be possible under any other arrangement; so that any alteration would be a positive disadvantage to the animal. If, as I consider probable, this fact should prove to be of much wider occurrence in nature than these instances show, it may serve to give us some slight glimpse of the mechanism by which the conservation of species in nature is secured. In astronomy, the conservation of the solar system depends upon certain well-known conditions regulating the motions of the several bodies of which that system consists; and it is a matter of indifference whether these conditions were directly imposed by the will of the Divine contriver, or were the indirect result of some former condition of the system. In either case, these conditions are equally the foreseen result of the contrivance. If the present state of the solar system be the result, according to fixed laws, of some pre-existing state of that system, it may be said, in the language of naturalists, to have been evolved out of its former state, but in such an evolution there was nothing left to chance; it was all foreseen, and the evolution itself presided over by the Divine mind that planned the whole. I cannot see why there may not be in organic life a similar process of evolution of higher from lower forms of existence; but it is a teleological evolution, in which every step and every result was foreseen and planned beforehand. The laws of such an evolution appear to me, in the present state of our knowledge, to be entirely unknown.

I have explained the similarity of muscles and bones in the vertebrate animals on simple teleological principles, without making use of the unproved hypothesis of their descent from a supposed common ancestor.

In the discussion of the theory of muscular types, and of the laws of fatigue and refreshment, I have succeeded in obtaining many new and interesting applications of exact science to the problems of animal mechanics.

I take this opportunity of returning my thanks to Dr. Alexander Macalister and to the Rev. Richard Townshend, who have assisted me materially in the anatomical and geometrical branches of my subject; and also, to the Provost and Senior Fellows of Trinity College, Dublin, for the assistance they have given me, by defraying a portion of the expenses of publication.

Popular Lectures on Scientific Subjects.

By H. HELMHOLTZ, Professor of Physics in the University of Berlin. Translated by E. Atkinson, Ph.D., F.C.S., Professor of Experimental Science, Staff College. With an introduction by Professor Tyn-dall. London: Longmans, Green, and Co. 1873.

THIS is a work of the highest merit, eminently adapted for the present times; upholding the education in practical mathematics and experimental science as the true course of instruction for our youths rather than classical and philological studies, supplemented, may be, by some small doses of ordinary scholastic mathematics, forgotten, perhaps, as soon as learned.

Most clearly are these views brought out and illustrated in the lectures before us, as the following passage taken from the lecture in the relation of natural science to general science emphatically affirms.

I do not intend (says the author) to go deeply into the question how far mathematical studies, as the representatives of conscious logical reasoning, should take a more important place in school education. But it is, in reality, one of the questions of the day. In proportion as the range of science extends, its system and organisation must be improved, and it must inevitably come about that individual students will find themselves compelled to go through a stricter course of training than grammar is in a position to supply. What strikes me in my own experience of students who pass from our classical schools to scientific and medical studies, is first, a certain laxity in the application of strictly universal laws. The grammatical rules, in which they have been exercised are for the most part followed by long lists of exceptions; accordingly they are not in the habit of relying implicitly on the certainty of a legitimate deduction from a strictly universal law. Secondly, I find them for the most part too much inclined to trust to authority, even in cases where they might form an independent judgment. In fact, in philological studies, inasmuch as it is seldom possible to take in the whole of the premisses at a glance, and inasmuch as the decision of disputed questions often depends on an aesthetic feeling for beauty of expression, and for the genius of the language, attainable only by long training, it must often happen that the student is referred to authorities even by the best teachers. Both faults are traceable to a certain indolence and vagueness of thought, the sad effects of which are not confined to subsequent scientific studies. But certainly the best remedy for both is to be found in mathematics, where there is absolute certainty in the reasoning, and no authority is recognized but that of one's own intelligence.

The practical utility of these studies is urged upon us in the following truthful and apposite statements:—

Knowledge is not the sole object of man upon earth. Though the sciences arouse and educate the subtlest powers of the mind, yet a man who should study simply for the sake of knowing, would assuredly not fulfil the purpose of his existence. We often see men of considerable endowments, to whom their good or bad fortune has secured a comfortable livelihood or good social position, without giving them, at the same time, ambition or energy enough to make them work, dragging out a weary, unsatisfied existence, while all the time they fancy they are following the noblest aim of life by constantly devoting themselves to the increase of their knowledge, and the cultivation of their minds. Action alone gives a man a life worth living; and therefore he must aim either at the practical application of his knowledge, or at the extension of the limits of science itself. For to extend the limits of science is really to work for the progress of humanity. Thus we pass to the second

link, uniting the different sciences, the connection, namely, between the subjects of which they treat.

Knowledge is power. Our age, more than any other, is in a position to demonstrate the truth of this maxim. We have taught the forces of inanimate nature to minister to the wants of human life and the designs of the human intellect. The application of steam has multiplied our physical strength a million-fold; weaving and spinning machines have relieved us of labours, the only merit of which consisted in a deadening monotony. The intercourse between men, with its far-reaching influence on material and intellectual progress, has increased to an extent of which no one could have even dreamed within the lifetime of the older among us. But it is not merely on the machines by which our powers are multiplied; not merely on rifled cannon, and armoured ships; not merely on accumulated stores of money and the necessities of life, that the power of a nation rests; though these things have exercised so unmistakeable an influence, that even the proudest and most obstinate despotisms of our times have been forced to think of removing restrictions on industry, and of conceding to the industrious middle classes a due voice in their counsels. But political organization, the administration of justice, and the moral discipline of individual citizens are no less important conditions of the preponderance of civilized nations; and so surely as a nation remains inaccessible to the influences of civilization in these respects, so surely is it on the high road to destruction. The several conditions of national prosperity act and react on each other; where the administration of justice is uncertain, where the interests of the majority cannot be asserted by legitimate means, the development of the national resources, and of the power depending upon them, is impossible; nor again, is it possible to make good soldiers except out of men who have learnt under just laws to educate the sense of honour that characterises an independent man, certainly not out of those who have lived the submissive slaves of a capricious tyrant.

From the general view of the subject we are conducted to the consideration of the physiological causes of harmony in music to ice and glaciers. The world of ice and of eternal snow, as unfolded to us on the summits of the neighbouring Alpine chain, so stern, so solitary, so dangerous, it may be, has yet its own peculiar charm. Not only does it enchain the attention of the natural philosopher, who finds in it the most wonderful disclosures as to the present and past history of the globe, but every summer it entices thousands of travellers of all conditions, who find there mental and bodily recreation. While some content themselves with admiring from afar the dazzling adornment which the pure luminous masses of snowy peaks, interposed between the deeper blue of the sky and the succulent green of the meadows, lend to the landscape, others more boldly penetrate into the strange world, willingly subjecting themselves to the most extreme degrees of exertion and danger, if only they may fill themselves with the aspect of its sublimity.

I will not attempt what has so often been attempted in vain—to depict in words the beauty and magnificence of nature, whose aspect delights the Alpine traveller. I may well presume that it is known to most of you from your own observation; or, it is to be hoped, will be so. But I imagine that the delight and interest in the magnificence of those scenes will make you the more inclined to lend a willing ear to the remarkable results of modern investigations on the more prominent phenomena of the glacial world. There we see that minute peculiarities of ice, the mere mention of which might at other times be regarded as a scientific subtlety, are the causes of the most

important changes in glaciers; shapeless masses of rock begin to relate their histories to the attentive observer, histories which often stretch far beyond the past of the human race into the obscurity of the primeval world; a peaceful, uniform, and beneficent sway of enormous natural forces, where at first sight only desert wastes are seen, either extended indefinitely in cheerless, desolate solitudes, or full of wild, threatening confusion—an arena of destructive forces. And thus I think I may promise that the study of the connection of those phenomena of which I can now only give you a very short outline will not only afford you some prosaic instruction, but will make your pleasure in the magnificent scenes of the high mountains more vivid, your interest deeper, and your admiration more exalted.

Let me first of all recall to your remembrance the chief features of the external appearance of the snow-fields and of the glaciers; and let me mention the accurate measurements which have contributed to supplement observation, before I pass to discuss the casual connection of those processes.

The higher we ascend the mountains the colder it becomes. Our atmosphere is like a warm covering spread over the earth; it is well-nigh entirely transparent for the luminous darting rays of the sun, and allows them to pass almost without appreciable change. But it is not equally penetrable by obscure heat-rays, which, proceeding from heated terrestrial bodies, struggle to diffuse themselves into space. These are absorbed by atmospheric air, especially when it is moist; the mass of air is itself heated thereby, and only radiates slowly into space the heat which has been gained. The expenditure of heat is thus retarded as compared with the supply, and a certain store of heat is retained along the whole surface of the earth. But on high mountains the protective coating of the atmosphere is far thinner—the radiated heat of the ground can escape thence more freely into space; there, accordingly, the accumulated store of heat and the temperature are far smaller than at lower levels.

To this must be added another property of air which acts in the same direction. In a mass of air which expands, part of its store of heat disappears; it becomes cooler, if it cannot acquire fresh heat from without. Conversely, by renewed compression of the air, the same quantity of heat is reproduced which had disappeared during expansion. Thus if, for instance, south winds drive the warm air of the Mediterranean towards the north, and compel it to ascend along the great mountain wall of the Alps, where the air, in consequence of the diminished pressure, expands by about half its volume, it thereby becomes very greatly cooled—for a mean height of 11,000 feet, by from 18° to 30° C., according as it is moist or dry—and it thereby deposits the greater part of its moisture as rain or snow. If the same wind, passing over to the north side of the mountains as Föhn-wind, reaches the valleys and plains, it again becomes condensed, and is again heated. Thus the same current of air which is warm in the plains, both on this side of the chain and on the other, is bitterly cold on the heights, and can there deposit snow, while in the plain we find it insupportably hot.

The lower temperature at greater heights, which is due to both these causes, is, as we know, very marked on the lower mountain chains of our neighbourhood. In central Europe it amounts to about 1° C. for an ascent of 480 feet; in winter it is less—1° for about 720 feet of ascent. In the Alps the differences of temperature at great heights are accordingly far more considerable, so that upon the higher parts of their peaks and slopes the snow which has fallen in winter no longer melts in summer. This line, above which snow covers the ground throughout the entire year, is well known

as the snow-line; on the northern side of the Alps it is about 8,000 feet high, on the southern side about 8,800 feet. Above the snow-line it may on sunny days be very warm; the unrestrained radiation of the sun, increased by the light reflected from the snow, often becomes utterly unbearable; so that the tourist of sedentary habits, apart from the dazzling of his eyes, which he must protect by dark spectacles or by a veil, usually gets severely sunburnt in the face and hands, the result of which is an inflammatory swelling of the skin and great blisters on the surface. More pleasant testimonies to the power of the sunshine are the vivid colours and the powerful odour of the small Alpine flowers which bloom in the sheltered rocky clefts among the snow-fields. Notwithstanding the powerful radiation of the sun the temperature of the air above the snow-fields only rises to 5°, or at most 8°; this, however, is sufficient to melt a tolerable amount of the superficial layers of snow. But the warm hours and days are too short to overpower the great masses of snow which have fallen during colder times. Hence the height of the snow-line does not depend merely on the temperature of the mountain slope, but also essentially on the amount of the yearly snow-fall. It is lower, for instance, on the moist and warm south slope of the Himalayas, than on the far colder but also far drier north slope of the same mountain. Corresponding to the moist climate of western Europe, the snow-fall upon the Alps is very great, and hence the number and extent of their glaciers are comparatively considerable, so that few mountains of the earth can be compared with them in this respect. Such a development of the glacial world is, as far as we know, met with only on the Himalayas, favoured by the greater height; in Greenland and in Northern Norway, owing to the colder climate; in a few islands in Iceland; and in New Zealand, from the more abundant moisture.

Places above the snow-line are thus characterised by the fact that the snow which in the course of the year falls on its surface, does not quite melt away in summer, but remains to some extent. This snow, which one summer has left, is protected from the further action of the sun's heat by the fresh quantities that fall upon it during the next autumn, winter, and spring. Of this new snow also next summer leaves some remains, and thus year by year fresh layers of snow are accumulated one above the other. In those places where such an accumulation of snow ends in a deep precipice, and its inner structure is thereby exposed, the regularly stratified yearly layers are easily recognized.

But it is clear that this accumulation of layer upon layer cannot go on indefinitely, for otherwise the height of the snow peak would continually increase year by year. But the more the snow is accumulated the steeper are the slopes, and the greater the weight which presses upon the lower and older layers and tries to displace them. Ultimately a state must be reached in which the snow slopes are too steep to allow fresh snow to rest upon them, and in which the burden which presses the lower layers downwards is so great that these can no longer retain their position on the sides of the mountain. Thus, part of the snow which had originally fallen on the higher regions of the mountain above the snow-line, and had there been protected from melting, is compelled to leave its original position and seek a new one, which it of course finds only below the snow-line on the lower slopes of the mountain, and especially in the valleys, where however being exposed to the influence of a warmer air, it ultimately melts and flows away as water. The descent of masses of snow from their original positions sometimes happens suddenly in avalanches, but it is usually very gradual in the form of glaciers.

Thus we must discriminate between two distinct parts of the ice-fields; that is, first, the snow which originally fell—called "firn" in Switzerland—above the snow-line, covering the slopes of the peaks as far as it can hang on to them, and filling up the upper wide kettle-shaped ends of the valleys forming widely extended fields of snow or "firn-meere." Secondly, the glaciers, called in the Tyrol "firner," which as prolongations of the snow-fields often extend to a distance of from 4,000 to 5,000 feet below the snow-line, and in which the loose snow of the snow-fields is again found changed into transparent solid ice. Hence the name glacier, which is derived from the Latin, *glacies*; French, *glace*, *glacier*.

The outward appearance of glaciers is very characteristically described by comparing them with Goethe to currents of ice. They generally stretch from the snow-fields along the depth of the valleys, filling them throughout their entire breadth, and often to a considerable height. They thus follow all the curvatures, windings, contractions, and enlargements of the valley. Two glaciers frequently meet, the valleys of which unite. The two glacial currents then join in one common principal current, filling up the valley common to them both. In some places these ice-currents present a tolerably level and coherent surface, but they are usually traversed by crevasses, and both over the surface and through the crevasses countless small and large water rills ripple, which carry off the water formed by the melting of the ice. United, and forming a stream, they burst, through a vaulted and clear blue gateway of ice, out at the lower end of the larger glacier.

The lecture continues the development of this subject to the fullest extent, concluding as follows:—

Thus to the eye of the natural philosopher the glacier, with its wildly-heaped ice-blocks, its desolate, stony, and muddy surface, and its threatening crevasses, has become a majestic stream whose peaceful and regular flow has no parallel; which, according to fixed and definite laws, narrows, expands, is heaped up, or, broken and shattered, falls down precipitous heights. If we trace it beyond its termination we see its waters, uniting to a copious brook, burst through its icy gate and flow away. Such a brook, on emerging from the glacier, seems dirty and turbid enough, for it carries away as powder the stone which the glacier has ground. We are disenchanted at seeing the wondrously beautiful and transparent ice converted into such muddy water. But the water of the glacier streams is as pure and beautiful as the ice, though its beauty is for the moment concealed and invisible. We must search for these waters after they have passed through a lake in which they have deposited this powdered stone. The Lakes of Geneva, of Thun, of Lucerne, of Constance, the Lago Maggiore, the Lake of Como, and the Lago di Garda are chiefly fed with glacier waters; their clearness and their wonderfully beautifully blue or blue-green colour are the delight of all travellers.

Yet, leaving aside the beauty of these waters, and considering only their utility, we shall have still more reason for admiration. The unsightly mud, which the glacier streams wash away, forms a highly fertile soil in the places where it is deposited; for its state of mechanical division is extremely fine, and it is moreover an utterly unexhausted virgin soil, rich in the mineral food of plants. The fruitful layers of fine loam which extend along the whole Rhine plain as far as Belgium, and are known as Loess, are nothing more than the dust of ancient glaciers.

Then, again, the irrigation of a district, which is effected by the snow-fields and glaciers of the mountains, is distinguished from that of other places by its comparatively greater abundance, for the moist air which is driven over the cold mountain peaks de-

posits there most of the water it contains in the form of snow. In the second place, the snow melts most rapidly in summer, and thus the springs which flow from the snow-fields are most abundant in that season of the year in which they are most needed.

Thus we ultimately get to know the wild, dead ice-wastes from another point of view. From them trickles in thousands of rills, springs, and brooks the fructifying moisture which enables the industrious dwellers of the Alps to procure succulent vegetation and abundance of nourishment from the wild mountain slopes. On the comparatively small surface of the Alpine chain they produce the mighty streams, the Rhine, the Rhone, the Po, the Adige, the Inn, which for hundreds of miles form broad, rich river-valleys, extending through Europe to the German Ocean, the Mediterranean, the Adriatic, and the Black Sea. Let us call to mind how magnificently Goethe, in "Mahomet's Song," has depicted the course of the rocky spring, from its origin beyond the clouds to its union with Father Ocean. It would be presumptuous after him to give such a picture in other than his own words:—

And along, in triumph rolling,
Names he gives to regions; cities
Grow again beneath his feet.

On and ever on he rushes;
Spire and turret fiery crested,
Marble palaces, the creatures
Of his wealth, he leaves behind.

Pine-built houses bears the Atlas
On his giant shoulders. O'er his
Head a thousand pennons rustle,
Floating far upon the breezes,
Tokens of his majesty.

And so beareth he his brothers,
And his treasures, and his children,
To the primal sire expectant,
All his bosom throbbing, heaving
With a wild tumultuous joy.

THEODORE MARTIN'S Translation.

The work also contains lectures on the Interaction of Natural Forces, the Recent Progress of the Theory of Vision, much of which we should like to transfer to our pages, but at present we must forbear.

Comets' Tails no Longer a Mystery, and a Few Questions. By J. A. R. London: Reeves, Son and Co., Playhouse-yard, Ludgate-hill, E.C.

THIS is a little book containing many illustrative woodcuts, and although we cannot endorse all the author's advances, we think it well worthy of attentive perusal. Much of the author's views are given in the following passages:—

When a comet is seen merely as nebula of an irregular form, that irregularity depends upon the vapours floating in the sphere capable of reflecting light, and as the whole revolves a constant change of form is a necessary consequence.

When a comet is seen in the distance, it receives so little light from the sun that the tail is often not seen, or seen very feebly, but as it approaches the sun, the tail increases in brilliancy and length, simply because that portion of the comet's atmosphere furthest from the sun, becomes better illuminated by the concentration of the light passing through the whole sphere, especially the central portion.

By adopting the theory that the nucleus consists of various aggregations and densities of gaseous matter, and that the whole revolves on an axis, there is no difficulty in accounting for all the changes which the tails assume; sometimes being single, at other times divided into two or more parts.

To strengthen the theory that the nucleus is partially made up of different aggregations of gas as before-mentioned, it is only necessary to refer to the descriptive forms ascribed to the nucleus by various astronomers.

It was computed that the comet of 1860

when nearest the sun travelled upwards of a million miles per hour, and that it changed the direction of its tail 150 degrees in five days. What then must have been the speed of the extremity of the tail?

It has always been most perplexing to account for any power capable of operating upon the tails of comets so as to impel them through such an almost inconceivable space in so short a time.

If the theory I have already suggested be correct, that comets have atmospheres surrounding them to the fullest extent of the tails, then so fast as they advance in their orbits round the sun, so fast do different parts of their atmospheres become illuminated by the sun's rays passing through them; and the change of positions takes place simultaneously with the rapidity of light, their tails being necessarily projected from the side furthest from the sun: and thus the whole difficulty, as to the rapid motions of the tails, is removed.

The appearance which sometimes occurs of an illuminated part projecting from the head towards the sun, may be accounted for by the nucleus reflecting back a portion of the light it receives from the sun, instead of allowing the whole to pass through. We know that if a round bottle of clear water is placed on a table, and a light at a distance is allowed to fall upon it, a large portion of the light passes through, and is concentrated beyond the bottle, but a portion is reflected back on the table towards the light—that which is reflected represents the head, and that which passes through represents the tail.

A horn or any other form of light seen between the nucleus and the sun is an evidence that the comet's atmosphere exists there, for we know that light is invisible until it fall upon some body capable of reflecting it.

By admitting that light is refracted through the nucleus, &c., colour of various hues is a natural consequence and needs no comment.

The pulsations of light which are generally seen passing from the nucleus through the tail, may be accounted for by this theory, inasmuch as the whole comet, including every portion of its atmosphere, is supposed to revolve on an axis, and is therefore in a constant state of change in the relative position of its parts. The outer portions of its atmosphere (like the earth's atmosphere) of course must have a slower motion than the more central; and as the light passing through the nucleus falls upon different portions or aggregations of the gaseous tail, as they are presented, so a flitting or pulsating effect is produced.

It is well known that the tails of comets are transparent, because stars can be seen through them; but the admission of their transparency has always created a difficulty, as transparent bodies are known to refract oblique rays of light, and cause objects seen through them to appear to alter their position, but with comets' tail no such effect has been observed for the stars (apparently) shine through the tails without refraction.

By way of illustrating the above, hold a piece of thick window glass in front of you, and look through it obliquely at an object in the distance; the object will appear in a different position from that in which it does without the interposition of the glass.

Now the question arises, if the tails are gaseous and transparent, why should not the light from the stars be affected in like manner?

Although this question has always been considered perplexing and never satisfactorily answered; by adopting the theory that the nuclei of comets are entirely surrounded by an atmosphere, as before explained, the problem becomes simple.

If the position of a star seen in close proximity to the tail of a comet be carefully ob-

served, the fact of the illuminated part called the tail passing in front, can have no effect whatever, either to increase or diminish the refraction of the light coming from the star, for the star is seen through the same medium as the tail a long time before the illuminated tail interposes, and therefore under the same refraction. When the tail has passed the star, no change of position of the star takes place until the atmosphere has travelled forward to a considerable distance.

The above I think is the solution of the mystery.

Our Seamen. An Appeal. By SAMUEL PLIMSOLL, M.P. London: Virtue and Co., 26, Ivy-lane, Paternoster-row. 1873.

WHATEVER may be the issue of the law proceedings now pending between Mr. Plimsoll, and the gentlemen who consider themselves maligned by the statements he has made in his book, yet this general verdict must, and we doubt not will, be pronounced by the public in the measures he has taken to arouse national action on behalf of safety of life and property at sea; and it is, that he deserves the hearty thanks of his countrymen for having stepped forward in a bold and uncompromising manner to deal with the monster evils arising from the use of badly-constructed and rotting vessels, overloading, and other preventable causes of maritime disaster.

Notwithstanding what officials (who are always bitterly opposed to unofficial interference), shipowners, and others may say, it has long been known that the evils we have referred to have existed for many years past, and have been increasing rather than diminishing. The Poor Jack has been little regarded by the shipowning interest; indeed, if special legal regulations had not been made with regard to him, he would probably, before this, have been reduced to a position on a level with the Russian serf; even, as matters now stand, he is liable to constrained service in a "coffin ship," unless he accepts the alternative of being sent to a criminal prison—there to do "hard labour" in company with murderers and felons, for the provisions of the law in his favour, by which he may escape, are both so arranged as to be, practically, all moonshine. Like all laws affecting the employed, when made by the employing class, they are tolerably well fitted to serve the interests of the latter, whilst they are but ill-fitted to protect the interests of the former.

The remedies for the evils referred to by Mr. Plimsoll involve scientific and practical questions, and must not be treated in an off-hand manner. In truth, we must confess that we consider that it will be very difficult to lay down a "hard and fast line" as to the proper construction of ships, load line, and the number of men required for the proper navigation of a ship; and we should prefer that some system of "surveying juries" of, say, five members of which practical seamen should form part, should determine these matters in the basis of certain broad general principles in each disputed case.

We refrain from quotations from this work the subject is so momentous, and the work so widely dissiminated that we think our readers should peruse it and judge for themselves.

The Races of Mankind, being a popular description of the characteristics, manners and customs of the principal varieties of the Human Family. By ROBERT BROWN, M.A., Ph.D., F.L.S., F.R.G.S., President of the Royal Physical Society, Edinburgh. Illustrated. Cassell, Petter, and Galpin, London, Paris, and New York.

THIS is a useful and entertaining serial, which we commend to the favourable consideration of our readers.

General Literature.

Unorthodox London; or, the Phases of Religious Life in the Metropolis. By Rev. C. MAURICE DAVIES, D.D. Tinsley Brothers.

THIS book is written in a very liberal spirit, and treats of a subject in which many people take a deep interest. Unorthodox London is, no doubt, exceedingly well-peopled, and by a strange variety of differing and opposing races. The very essence of our Protestantism is an honest toleration. The positive portion of our various creeds is honest, clear, and distinct enough. Our negative side is also understood, and fiercely disputed about; but, however we may condemn heresies, and however strongly we may prize the truth, we still know how to keep our zeal under the control of reason, and to carry on our discussions, and fire off wordy discharges at each other without injury to life or limb. What is it to the majority of our people that Mr. Conway preaches a humane liberalism at South-place?—that Professor Huxley or Mr. Voysey teaches at St. George's Hall?—that the followers of Johanna Southcott meet at the house of a cooper in Westmoreland-road, Walworth?—that there are "Plumstead Peculiars," "Mediums," and heaven knows what beside? We believe they are all good citizens, who follow their occupations, pay their taxes, and pray on Sundays in their own way without interference by the law or by the lawless, who too frequently, under the influence of pious zeal, take the law into their own hands.

We by no means say that a right choice of religious faith is unimportant. The writer of this book in no way commits himself to any set of opinions beyond what his profession as a clergyman indicates. He describes, but never, fortunately for himself and his readers, argues. Hence the reader may trust himself with him very safely, and if he has the courage to do so he will find himself introduced into a very strange world of varied and conflicting opinion, quite interesting, and it may be added very necessary to be understood by all who take any interest in the special thoughts by which religious society in England is characterized.

Kenelm Chillingly: His Adventures and Opinions. By the author of "The Caxtons." Blackwood, Edinburgh and London. 3 vols.

THERE is always something interesting in "the last," whether word or act, of any great man. In the highest sense, Lord Lytton was not a great man, but there was something in his life and labours which greatly interested the public, and which, upon the whole, caused his labours to have more of an influence than either their power or originality entitled them to. His early poems, plays, and novels were cleverly, and sometimes brilliantly, rhetorical, but nothing more. We imagine that of all the poetry he has written, not two lines have ever been quoted as apt for the illustration of any human thought or situation; whilst those of his dramas which have kept the stage have seldom found readers in the closet, or excited admiration apart from the "scenery, machinery, and dresses" of the theatre.

Of his first novels much might be said in commendation, but very much more in censure. "Paul Clifford," with its dashing scenes and flippant paradoxes, was a pleasant contrast to the dull volumes of the day. Scott, after all, was a school in himself, and stood apart from others in the interest he excited. Outside Scott, however, Bulwer, as he was then called, offered great attraction to the ordinary visitor to the circulating library; and his "Eugene Aram," and other early books, though as false to life and fact as they well could be, were still exciting, and gave many a reader a sensation through the

feeling who would in vain have sought for such a pleasure through the brain. It should be said, however, that this sensational or early style was greatly altered, if not entirely abandoned, in Lord Lytton's later works; and this now under notice, which has in it the last touches of the dying man's hand, may be favourably compared with even the best of the works given to the world even in his best days.

Kenelm Chillingly is a noble young fellow, whose fortunes it is interesting to follow; though, when he enters on ground with which experience has made us familiar, we cannot help discovering something rather stagey and unreal in the life depicted. The sketch of Chillingly miners is clever, but it is questionable whether a London editor ever carried about in his head such aphorisms as those treasured and shed abroad by Mivers, editor and proprietor of *The Londoner*. "Never tell people you are ill" is good advice in a sense, but not in the sense stated by Mivers. "Don't trouble other people with your ailments" is sound advice, but he must be a clever fellow who can follow Miver's advice, and conceal them from himself. "If you want to keep young live in a metropolis" is no more true than the opposite, namely, if you want to get old live in a metropolis. "Don't be a family man, nothing ages one like matrimonial felicity and paternal ties." This is quite true if the wife is disagreeable, and the children unruly, but otherwise this piece of advice, as the sailors say, is only fit for the marines. A good deal of editor's wisdom is nonsense, but that is so commonly the case with London editors that few will be surprised at it in Mivers Chillingly. Much of the action of the story is natural enough, and the characters pleasant and amusing, though in a high sense never instructive. Lord Lytton tries to teach but in the best sense; either as to thought or life, he never can shine as a teacher whom it would be safe to follow. Some few of the poems really are good, this, for instance—

THE FLOWER GIRL BY THE CROSSING.

By the muddy crossing in the crowded streets
Stands a little maid with her basket full of
posies,
Proffering all who pass her, choice of knitted
sweets,
Tempting age with hearts-ease, courting youth
with roses.
Age disdains the heart's-ease,
Youth rejects the roses;
London life is busy.
Who can stop for posies?

One man is too grave, another is too gay;
This man has his hot-house, that man not a
penny;
Flow'rets, too, are common in the month of May,
And the things most common least attract the
many.
Ill on London crossings
Fares the sale of posies;
Age disdains the heart's-ease,
Youth rejects the roses.

Lily, the loving, sweet-tempered girl, is the gem of the book, which is well worth reading for her sake alone, and in the belief that she will find many admirers we commend her to the affectionate attention of our readers, and whatever we may think of the short-comings of Lord Lytton's volumes, we sincerely regret that the hand that penned them is still for ever.

Faust. A Tragedy by Goethe. Translated in Rhyme by C. KEGAN PAUL. London: King and Co.

IT is a question fairly to be asked whether the non-German reader will ever get a satisfactory translation of "Faust?" Great poems are absolutely untranslatable, and "Faust" is, in almost every sense of the word, a great poem. The poet penetrates even to the "last recesses," thought, feeling, life. From the highest cogitations, which includes the almost boundless wonders of creation to the finest shade of individual

feeling, begotten by the child on the mother's knee—from the blackest dreams of melancholy superstition to the brightest hopes of the limitless future—the imagination of the true poet penetrates; and in Goethe this wonderful all-including power, searched after the half-revealed and unrevealed, and until some poet, with a power almost equal to his own, shall follow his thoughts, and give them to us in the spirit and manner in which he would interpret nature herself, we shall never understand in its intensity or feel in its beauty the wonderful world that the great German poet has revealed to those who are qualified by a knowledge of German and the feeling associated with the first lisps of language on a mother's knee, to follow him into those profound depths of thought, or to soar with him in those aerial flights where he moves on outspread pinions and with an almost divine calmness.

Some few of Goethe's works have been well translated. Coleridge and Carlyle, what they have done, have left little to be desired; but "Faust" has mastered all who have touched it. What Shelley might have accomplished had he been spared to go thoroughly through with the translation began it is now difficult to say. What he has left is done in the best way; but it is to be feared that the quiet domestic home passages would have lost much of the charm in our wild young English poet's hands. As matters stand, we have no adequate translation of "Faust." Dr. Anster's, which is by far the most readable, is not a close translation; whilst Backie's, which is almost literal, is crank and unenjoyable. That by Lewis Filmore is done with loving fidelity and tenderness, but in the sublime passages it lacks penetration of eye and sweep of wing. Mr. Kegan Paul has, however, tried, though without complete success, to unite the literal and the poetical, to give us the plain and the abstruse, and sometimes this is done in a manner that all but satisfies. A comparison or two from Mr. Paul's work with that of other writers will explain differences better than any amount of critical disquisition. Let us take the "Soldier's Song." Filmore's translation runs thus:

Towns begirt with walls and moats,
Maids of proud and lofty thoughts—
Strong without and strong within—
These are what I love to win!
Bold is the attempt and hard,
But as noble the reward.

Summon'd by the trumpet's breath,
We go to rapture or to death;
For 'tis amid the battle's strife
Thrills the rush—the life of life!

Maiden's heart and city's wall
Were made to yield, were made to fall;
Bold is the attempt and hard,
But as noble the reward;
When we've held them each their day
Soldier-like, we march away!

This is somewhat in Goethe's manner, but not much. Bayard Taylor, handling the trifle, does much better; there is more of the soldier's recklessness of spirit in it:—

Castles with lofty
Ramparts and towers,
Maidens disdainful
In beauties array,
Both shall be ours!
Bold is the venture,
Splendid the pay!

Lads, let the trumpets
For us be suing—
Calling to pleasure,
Calling to ruin.
Stormy our life is,
Such is its boon!

Maidens and castles
Capitulate soon.
Bold is the venture,
Splendid the pay!
And the soldiers go marching,
Marching away.

This has a good deal of the requisite air of spirit; indeed, it is the best of

three; but we must allow Mr. Paul's to speak for itself, for although the song, at best, is but a trifle, we see most the defects or excellences of the artist's hand :—

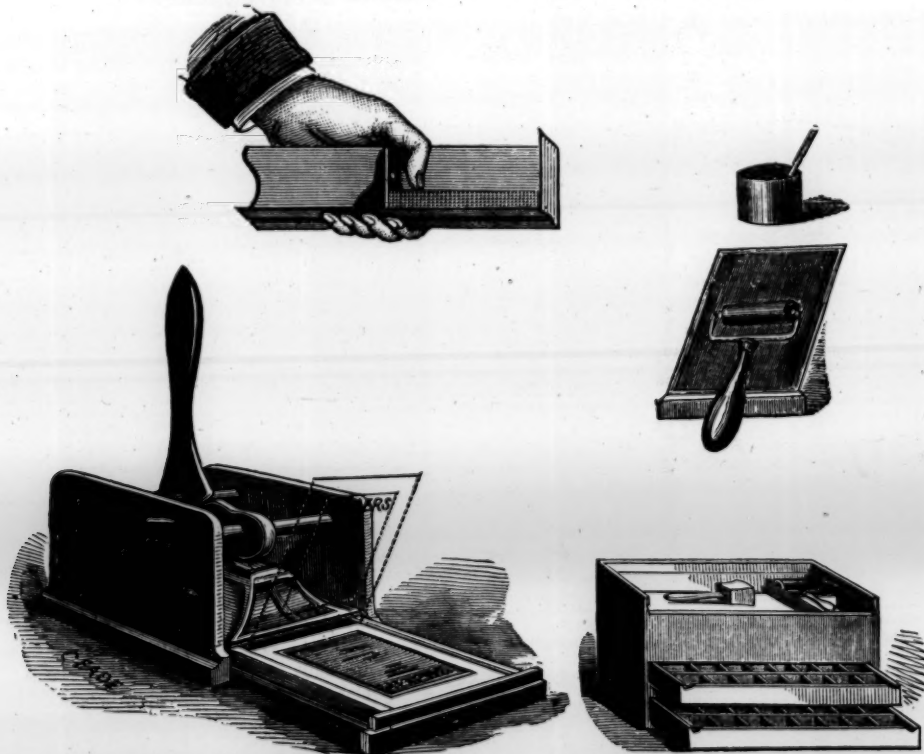
Cities and tower,
Walled o'er the plain,
Maidens with haughty,
Scornful disdain,
These would I gain!
Keen is the struggle,
Lordly the pay!
Rings out the bugle,
Rousing us all,
Whether we conquer,
Whether we fall.
This is a storming!
That is a life.
Cities and maidens
Yield in the strife.
Keen is the struggle,
Lordly the pay!
Soon are the soldiers
Up, marching away.

We cannot think that this new translation of Mr. Paul's will give the general reader any higher idea of Goethe's genius than he already has, but it is nevertheless so well done that it will repay the English admirers of the German poet to peruse it. Mr. Paul has done his work lovingly and well; and it

he has not succeeded where all others have failed, the attempt, at least, is well made, and we have not the least doubt, though there are numberless translations of Goethe's masterpiece, this additional one will be welcomed by all who take a pleasure in the study of German literature. We have not touched the graver parts of the work; to do that would call for more space than we can conveniently give to a subject already worn to triteness by criticism.

THE ENFIELD IRON WORKS AND INVENTIONS' DEVELOPMENT COMPANY, LIMITED.—Under this title a company has been formed, with offices, 101, Leadenhall-street, for the purpose of aiding inventors in the practical realization of their inventive projects. Time will show whether the undertaking will prove a success, but the name of Mr. Joseph Newton, A.I.C.E., the justly esteemed President of the Association of Foremen Engineers, late of the Royal Mint, leads us to take a favourable view of its prospects; however, we think it will be found that success will be best attained by the company restricting its operations to certain classes of inventions. The whole field of invention seems too vast and varied for one company to deal with.

THE COMBINED PORTABLE CAM LEVER PRINTING AND COPYING PRESS, WITH PRINTING OFFICE COMPLETE.



EVERYONE his own printer might appositely have been selected as the title of this invention, as it will be found to combine simplicity of construction, durability, and cheapness. It is admirably adapted for the use of chemists, florists, professional men, merchants, bankers, stationers, steamship, railway and joint stock companies, hotels, music halls, restaurants, auctioneers, schools, missionaries, explorers, colonists, museums, the army and navy, and all tradesmen who require cards, invoices, circulars, labels, bills of fare, memorandums, addressed envelopes, hand-bills, &c.

By this "portable printing office," as it may be termed, every kind of printing can be done up to 13 inches by 8½ inches; it is, therefore, not a toy machine, but one of real practical use, the facts of which are fully substantiated by the very extensive sale it has had. Eight hundred having been manufactured and supplied since March 1872.

Her Majesty's Government, the Spanish, and several other Governments have, we are informed, patronized this invention, and, owing to its great usefulness and portability,

have adopted it for their office and field uses, and it has been found to be of great service, both in despatch and economy, the whole arrangement being so simple that it is worked by the soldiers with ease and readiness both in camp and when on the march.

It is also highly appreciated for general office use in consequence of the peculiar advantage it has of being immediately converted into a powerful and superior copying press, as you have simply to remove the "type carriage" to admit the letter book.

They are so compact and portable that the whole printing office complete could stand in a recess of two or three feet square, and can be worked effectively in the same space.

This apparatus can be made to any size, and to suit the requirements of all trades, at proportionate prices, and can be manufactured with iron surfaces especially adapted for hot climates. The accompanying illustrations need no detailed description.

The agents for this invention are Messrs. Adutt, Finzi, and Co., 24, Mark-lane, London, E.C., sole manufacturers of the patent "Anti-Mildew Grain and Seed Protector," patronised by Her Majesty the Queen.

BLOTTING-PAPER MADE DOUBLY USEFUL.

MESSRS. De Lara and Co., 154, Fleet-street, have patented a system by which account books, diaries, and other works of the same useful class, are interleaved and are more than doubled in value, without being increased in bulk or price—increased in value, because the blotting-paper, hitherto useless except as absorbing the surplus ink from the other pages, now contains important information and business notices, which no book of the kind had previously included. This result has been achieved by a peculiar preparation of the paper, so that, while losing nothing of its original value for blotting purposes, it offers an excellent surface for printing and becomes, in fact, a very considerable addition to the available contents of the book.

It was thought that all possible contrivances for the benefit of the advertiser had been exhausted—that ingenuity could find no other outlet for his announcements; but here is a new and vast field open for enterprise. The account book goes everywhere, into the hands of everybody. The tradesman issues a book to his customer; the customer has it at hand continually. When the account book at present in use is opened, on one side are the written entries, on the other a pink, spongy-looking blank, with a cross-hatching of blotted impressions, ugly to look at, and of interest to none. The new account book, patented by Messrs. De Lara and Co., is interesting on every page. The blotting traces of the well-used book are there indeed, but they cannot obscure the bright, legible information printed on the firm blotting-paper now in use. Printing-ink has beaten writing-ink ever since printing was invented, and it beats it now. Every time the book is opened, there is something which arrests the attention, some advertisement containing the information which it is desirable to possess—some business address, some intimation where to obtain an article of utility or ornament, which the housekeeper has been long desiring to know about, and which will not now be forgotten, because it will meet her eye half a dozen times a day.

Take in hand one of the books now furnished by tradesmen to their customers, or a private account book. There are perhaps thirty-two ruled pages for accounts, and there are also thirty-two pages of blotting-paper, which, except for mere blotting, is the veriest waste of waste substances. It cannot be written on, if a hasty memorandum is required; it is too rotten even for a spill to light the gas or cigar. It is a perfectly useless member of the paper community; and the poet Shelley, who had a mania for making and floating paper-boats, and once, in default of other material, folded up a five-pound note in the required shape, would have been in despair if he had only been in possession of a leaf of blotting-paper.

Messrs. De Lara believe their improvement will be appreciated by business men and careful domestic managers, who like to know what good things are obtainable, and where they are to be obtained. The new book is at once a household directory and a household price current. Immediately it was announced, the publishers were satisfied they had hit upon a good idea. Promises of support have, it appears, been received from every quarter, and advertisers were eager to secure a position in the pages.

Blotting-pads, to use a familiar phrase, "bristling with information," with monthly calendar, postal rates, tables of interest and wages, cab fares—everything, in fact, which can be desired for desk reference, are to be issued; and diaries, the most comprehensive and the cheapest ever offered, are in active preparation. The value of these books, increased in contents so greatly by the new process, without the slightest increase of price, is so obvious, that we confidently leave the matter to the attention of our readers.

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Editor's Office: 21, Cockspur Street, Charing Cross, S.W.

THE INVENTORS' INSTITUTE,

4, ST. MARTIN'S PLACE, TRAFALGAR SQUARE, LONDON.

ESTABLISHED 1ST MAY, 1862.

Past Presidents:

SIR DAVID BREWSTER, K.H., LL.D., F.R.S., &c., from the establishment of the INVENTORS' INSTITUTE, till his decease, February, 1868.

LORD RICHARD GROSVENOR, M.P.

Chairman of the Council:

SIR ANTONIO BRADY.

NOTICES.

THURSDAY, JUNE 12.—A paper on "Bogs, and the Best Means of Making Them into Fuel, and Turning Them to profitable account by Drainage for Agricultural Purposes." By PETER LOVE, Esq., M.E., to be followed by discussion.

Monthly Notices.

The death of the late Mr. R. M. Latham, as already mentioned in the columns of our present issue, has been the principal topic of the month amongst inventors and members of the Inventors' Institute. It will be seen by reference to our report of the proceedings of the Institute, that a vote of sympathy and condolence to his widow has been passed by the Council and Annual General Meeting. This tribute is one fairly due to the memory of the deceased.

We have much pleasure in noticing the fact that a large meeting, at which Alderman Cotton presided, was held in Guildhall on the 20th May, with the view to promote the establishment of Tribunals of Commerce. The meeting was addressed by Mr. Lyne, the chairman of the Tribunals of Commerce Association, who for many years past has been working in behalf of the establishment of these Tribunals; also by Mr. F. W. Campin, the barrister, who stated that what was needed was the establishment of Tribunals, in which duly qualified commercial men should act as adjudicators and proceed to settle disputes between men of business in a summary and inexpensive way, upon the basis of trades customs and usages, without the cumbrous and costly procedure of courts of law, or adherence to antiquated precedents and legal fictions. Not that the advice of lawyers upon legal points ought to be excluded from the operations of these Tribunals; but the legal element must be kept from being predominant, and rendered co-operative. He also advocated a department of Tribunals of Commerce, in which scientific and technical men should be called in as adjudicators for the settlement of disputes in patent cases. He remarked that in appointing adjudicators the Livery Guilds might be resorted to with advantage. Sir John Bennett, Mr. Griffith, Mr. Ex-Sheriff Hutton, and other gentlemen supported these views, and a committee to carry on operations in behalf of Tribunals of Commerce drawn from the persons attending the meeting was formed, of which Mr. J. R. Taylor is the Secretary.

The Inventors' Institute.

At the usual meeting of the Council held previous to the ordinary members' meeting on Thursday, the 8th day of May, 1873, Mr. Hume Williams, Vice-Chairman of the Council, presided.

Mr. WILLIAMS, having taken the chair, stated that the principal business of the meeting was the consideration of some fitting expression of the feelings of the Council with reference to the death of the Secretary, Mr. R. Marsden Latham. He knew that all the members of the Institute must feel the deepest sorrow at the death of the late lamented Secretary. He (the Chairman) had been associated with Mr. Latham, in founding the Inventors' Institute, and had worked with him ever since. Mr. Latham was a most able Secretary, and it was mainly due to his intelligent action that the Inventors' Institute possessed the high position it now maintained. Under these circumstances he was sure that all present would feel desirous that some fitting acknowledgment of his services to the Society should be made. He concluded by stating that a resolution of condolence and sympathy with his widow ought to be prepared forthwith, and as this could not be well done at a meeting like the present, he thought the question should be referred to a Select Committee; whereupon

Mr. M. M. HARRIS proposed, and Mr. COULTHARD seconded, the following resolution:—

"That Mr. Hume Williams, Mr. Campin, Mr. F. H. Varley, and Mr. Carttar be requested to frame such a resolution of condolence as may convey the sense of the Council and Institute of their appreciation of her late husband, and their deep sorrow for his loss."

This being put to the vote was carried unanimously.

Mr. HUME WILLIAMS then proposed, and Mr. F. H. VARLEY seconded, a resolution, that Mr. F. W. Campin be, and is hereby requested to accept the position of Secretary of the Institute, in the room of Mr. Latham, deceased, and that he be offered the same salary as that paid to Mr. Latham.

It being stated that the banking account, which stood in the names of Mr. Hume Williams, Mr. F. W. Campin, Mr. Coulthard, and others, could only be drawn upon by cheques, countersigned by the Secretary,

It was resolved that the bankers be requested, upon receiving cheques bearing the signatures of Mr. Campin and the other signatories, to duly pay the same without any cross signature.

It was also resolved that in consequence of the death of the late lamented Secretary of the Institute, and as a mark of respect to his memory, the ordinary members' meeting for the evening should be dispensed with.

At a council meeting held on 22nd May, previously to the general meeting, a resolution of condolence, as incorporated in the council's report, was passed as part of it.

The annual general meeting of the Inventors' Institute for the year ending May, 1873, was held at 4, St. Martin's-place at four o'clock p.m. on Thursday, 22nd of May, 1873, when Hume Williams, Esq., was unanimously voted to the chair.

The CHAIRMAN, in opening the proceedings, in eloquent terms, referred to the loss sustained by the Institute by the death of the late Secretary, Mr. Latham, who had, he might say, been called away in what appeared to be the very midst of a career of much usefulness and great promise, differing in this respect from the losses heretofore sustained by the association by the deaths of Sir David Brewster, the late President, Richard Roberts, C.E., and Professor McGanley, all of whom had been allowed by Providence a term of life more nearly approaching the allotted span of human existence. He concluded by remarking that Mr. Latham's death made it necessary that all members of the Institute should co-operate for the purpose of maintaining it on a good footing. He then called on Mr. CAMPIN, who acted as Secretary by direction of the Council, to read their report.

The report was then read. (See next page.)

On the motion of the CHAIRMAN, seconded by Mr. T. BLANCHETT, the report was unanimously received and adopted.

The CHAIRMAN then moved, and Mr. T. BLANCHETT seconded, and Mr. D. J. McLAUCHLIN supported, the appointment of Mr. F. W. Campin as Secretary of the Inventors' Institute, in the room of Mr. Latham, deceased, which was carried unanimously.

The Council for the last year were re-elected.

The auditors were re-elected.

It was then moved by Mr. McLAUCHLIN, seconded by Mr. REGAN, that the thanks of the meeting are due, and are hereby accorded to Sir Antonio Brady, the Chairman, and the members of the Council for the past year, for their efficient services during the year of office.

Mr. HUME WILLIAMS then returned thanks on behalf of the Council, as also to a vote of thanks to himself for his conduct in the chair at the annual meeting, and with this the proceedings terminated.

ANNUAL REPORT OF THE COUNCIL OF THE INVENTORS' INSTITUTE, 1873.

THE Council of the Inventors' Institute, in presenting the eleventh annual report, do so under a feeling of great depression. The recent decease of the lamented secretary, Mr. Robert Marsden Latham, who was also one of the founders of the Institute, has cast a gloom over them which they find it no easy task to dispel.

Moreover, the almost sudden death of the secretary, just at the time when the Annual Report should be in preparation, has not only deprived them of his able assistance in drawing it up, but has considerably hindered them in collecting and arranging those details of the progress of the Society, and the great questions it has to deal with, which they would feel it incumbent upon them to lay before the annual general meeting.

In the commencement of the present year, in May last, the subject of the Patent Laws was occupying much of their attention in consequence of the then recent publication, as a Parliamentary paper, of the Report, with the evidence, of the Select Committee of the House of Commons on Letters Patent for Inventions, which Report was printed *in extenso* in the numbers for June 1872, and February 1873, of the journal of the Inventors' Institute (SCIENTIFIC AND LITERARY REVIEW). This Report has led to much discussion at various meetings of the Council, and of the members of the Institute, and has been referred to a special sub-committee to consider and report *seriatim* on the various points raised in of the House of Commons Committee's Report. This sub-committee has held several meetings and considered the different paragraphs of the House of Commons Report; they have, however, delayed the completion and presentation of their own Report in consequence of the peculiar position of the Government on this question, it having been, in the first instance, communicated to the Secretary of the Institute by one of her Majesty's Law Officers that the Government did not intend to introduce any measure of Patent Reform into Parliament during the present Session; and afterwards it was confidently reported by Members of the House of Commons that the present Lord Chancellor (Lord Selborne) intended to bring forward a Bill in the House of Lords; but, now this intention appears to be abandoned. Lord Selborne being, however, a well-known declared opponent of any system of Patent Laws, the Council would take this occasion of warning inventors against placing any reliance on the assumed action or non-action of the Government as at present constituted, and any measure introduced by Lord Selborne the Council have no right to expect would be favourable to the inventor's interests. Further, it is evident that the present position of the Patent Law question is of a critical character necessitating the utmost watchfulness on the part of the Council and other members of the Institute and inventors generally, hence the Council would urge all friends of the inventors' cause to come forward and support this Institute in its efforts, for the maintenance and protection of inventors' rights.

Besides the great question of Patent Law the Institute has given much attention to various matters likely to interest inventors. At the usual fortnightly meetings of the members the following questions, amongst others, have been discussed:

Inventions relating to telegraphy, which formed the subject of a very able and interesting paper by Mr. F. H. Varley, F.R.A.S. (member of the Institute).

Technical education, by Mr. F. W. Campin.

On the bursting of pipes from the effects of frost, by Dr. J. A. Calantarients.

On Tribunals of Commerce as available for Patent adjudications, by Mr. J. R. Taylor.

These papers led to prolonged, and sometimes adjourned discussions, full reports of

which will be found in the journal of the Inventors' Institute.

The approaching Patent Congress at Vienna formed the subject for consideration at some recent meetings of the Council and Institute, when it was agreed that delegates should be sent to represent the Society at that Congress.

The lamented death of Mr. Latham calls for the attention of the members of the Institute in regard to some testimonial to his worth and memory being accorded to his family, and the Council suggest the following resolution for adoption by the meeting:—

"The Council and other members of the Inventors' Institute now assembled, hereby desire to present to Mrs. R. M. Latham the tribute of their heartfelt sympathy and condolence in the loss she has sustained by the death of her late husband, Robert Marsden Latham, Esq., secretary and one of the founders of this Institute. They feel that whilst she mourns over the loss of an estimable and beloved husband, the Institute has to deplore the departure from its midst of an officer and member who did much to give it that high rank it now holds amongst the institutions of the country."

The decease of Mr. Latham also calls attention to the question of supplying the vacancy in the office of Secretary, and the Council, at the last meeting, passed the following resolution:—"That Mr. Campin be requested to accept the position of Secretary of the Institute in room of Mr. Latham, and that he be offered the same salary as that paid to Mr. Latham." In accordance with this resolution Mr. Campin signified his intention of offering himself for election, and agreed to transact any business that required the attention of the Secretary till the general meeting.

The audit of the accounts has, in consequence of the recent decease of the Secretary, been of a cursory character. The balance sheet, as presented, shows the position of the Institute, and the necessity of continued exertion on the part of the Executive in sustaining and improving its financial position. The Council had arranged for the usual annual dinner, but the illness and death of the late Secretary has led to the abandonment of that project. They hope, however, to be able to arrange for a dinner of the members and friends taking place early in the next Session.

THE IRONWORKS OF THE PHARAOHS.

AN English gentleman, travelling in these parts (near Sinai), was struck with the small blue stones he discovered in the dried-up watercourses which in the rainy season convey the thousand streams that hurry to the sea, and, having the curiosity to bring some home, he soon discovered that they were turquoises of no common order. This determined him to make further researches. Eventually he has built a house near the junction of the Wady Kenuch, the Wady Mokatteb, or the written valley, and the Wady Megham. Here, aided by the friendly tribes he has taken into his pay, he has discovered the old turquoise mines of the ancient Egyptians, the rocks that they worked for the stones, the very tools they used, and their polishing and grinding places. Being a man of much energy, he has brought to bear upon this fortunate discovery, the advanced knowledge of our times, and he is obtaining and sending over to this country some of the finest specimens of turquoises that exist. In such a lonely spot, he naturally has not confined his attention to this subject only, but has traced out the system of fortifications by which the Pharaohs protected their works and workmen, and, what is still more wonderful, has come upon the remains of vast ironworks, so

vast, indeed, that many thousand people must have been employed upon them, unless the plant used was on quite as grand a scale as that of our largest furnaces in the north of England. These works stand adjacent to the mines, on some hills at a place called Surabit-el-Khadin, and were evidently conducted on the Catalan system (in the opinion of their discoverer). The ore was very imperfectly extracted—slag brought over to this country, from the immense heaps that, like mountains, are piled around, contained as much as fifty-three per cent. of iron. This district has remained unexplored, probably, on account of its being out of the beaten track; and in an unknown country, there is no temptation to stray, particularly as the guides and dragomen discourage any explorations which may add to the risk of the journey. It is, however, much to be desired, that, now that attention is directed to the locality, and moreover, since the thorough investigation of its sites is likely to prove exceedingly profitable, that the enterprise and desire for knowledge of our scientific explorers may find help from the ready hand of some of our commercial magnates, and thus, that a past book in the world's history may, by English perseverance, be re-opened.—*Iron*.

MAN ENGINES.

FOR the purpose of lifting the miners out of deep mines without the use of rope and kibble, man engines were invented forty years ago by Bergmaster Dörrell, of Clausthal, in the Upper Harz, when he used two pump rods, which, side by side, went up and down a shaft, and fixed to them small platforms and handles at all those points of the rods which came opposite after every stroke. So, by simply changing his stand after each stroke, from one rod to the other, a man would be lifted up to the surface without any exertion. This ingenious system, says a correspondent of engineering, was soon imitated in other parts of Germany, Belgium, France, and England, and generally special machinery was designed to drive these man engines. At the deep silver lead mines of Příbram, in Bohemia, since 1854, in the Maria shaft, a direct acting man engine, with two steam cylinders and catract reversing gear, has been employed, both rods being connected by chains which run over pulleys; the great wear and tear of the latter, however, the great pressure of steam required, the inequality of the engine stroke when differently loaded, and other inconveniences, caused this direct acting engine to be abandoned and replaced by another indirect acting man engine in the Anna shaft. This latter was constructed so as to transmit the up and down motion from a rotating crank by two pump crosses—by-the-by, exactly the same principle which was originally employed by the inventor. This system is now quite successful at Příbram, and a small condensing steam engine, working expansively, is quite sufficient to work it with the greatest safety and regularity, a brake attached to the flywheel controlling the engine with certainty whenever required. The engine reaches a depth of 400 fathoms, and 3,000 men go up and down it daily, in about nine hours (three hours for each shift); it makes four to five strokes per minute of 10 ft. each, requires 6.2 to 6.9 lbs. of coal per hour, and per effective horse power, and costs from 2s. to 2s. 3d. per horse power in twenty-four hours. Quite recently the old engine in the Maria shaft has been also replaced by a similar one, only the stroke of the rods has been increased to 12 ft.—*Scientific American*.

We recommend to the notice of our commercial friends the "Planters' Gazette and Commercial News," full notice of which will be found in our advertising columns.

Proceedings of Societies.

THE INSTITUTION OF CIVIL ENGINEERS.

APRIL 29TH, 1873.—T. Hawksley, Esq., President, in the chair. The paper read was "On the Rigi Railway," by Dr. William Pole, F.R.S., M. Inst. C.E. This communication was written in consequence of a suggestion from the council, that members travelling abroad would do well to communicate to the Institution information as to any remarkable engineering works they might meet with in foreign countries; the author accordingly offered a short account of a railway he had lately seen in Switzerland of a peculiar character. The object of this railway was to convey passengers to the top of the Rigi, a mountain near Lucerne, from which there was a view so celebrated as to attract large numbers of visitors in the summer months. There was no carriage road, and the only means of ascent had hitherto been either by walking, or by horses, or by *chaises à porteurs*. A few years ago M. Riggenschach, the superintendent of the railway workshops at Olten, proposed to make a railway to the summit; but, on account of the great height, 4,500 feet above the plain, an unusually steep gradient, about 1 in 4, was necessary. There were objections to the use of stationary power, and M. Riggenschach devised a means of ascending by a rack and pinion arrangement, similar to that proposed and constructed by Mr. Blenkinsop in 1811, in the infancy of railways. The necessary concessions were obtained from the Cantonal Governments, and as the money was readily to be had, the railway was commenced in 1869. It was delayed during the French war of 1870, by the non-delivery of some rails ordered in that country, but it was opened for work in 1871. The line commenced at Vitznau, on the Lake of Lucerne, and was about 4 miles long. There was nothing remarkable in the works, which were mostly formed by cutting and benching on the rocky slope of the mountain. There was but one short tunnel, and only one iron bridge over a ravine. The gauge was 4 feet 8½ inches, and the rails were of the Vignoles shape, weighing 34 lbs. to the yard; a good example of a light railway on a standard gauge. The rack was placed midway between the rails, and was formed of two wrought-iron cheek plates, having wrought-iron teeth inserted between them, and riveted on each side. The pitch was nearly 4 inches. The locomotive weighed about 12 tons, and was supported on four wheels. The boiler was vertical, and its axis was inclined to the base line, so as to be nearly upright when running on the steep gradient. The crank shaft worked by gearing to the main axle, on which the cog-wheel was placed. This wheel was about 25 inches in diameter, and was formed of the best cast steel, the teeth being carefully shaped by machinery. Only one carriage was attached to each train; this was 28½ feet long, by 10 feet wide, and held fifty-four passengers.

The author minutely described the precautions taken to provide against the danger of accident, as these formed the most prominent features of the plan. In the first place the speed was very slow, not exceeding 3 or 4 miles per hour, either up or down. At this speed all the numerous risks of damage which resulted from velocity of motion entirely disappeared. The danger of getting off the rails (which with precipices of thousands of feet close alongside would be most formidable) was met by clips fastened to the vehicles, which passed under the rack bar, and would, if the wheels should run off, prevent the carriages from getting away. The risk of running down could not be met by breaks of the ordinary kind, as the friction would be ineffective on such a steep incline. Accordingly clip-breaks were provided, which embraced drums on the cogged wheel axles, so that when these clips were

tightened, the cogs held fast in the rack, and thus supported the weight of the vehicle. There were two of these breaks to the engine, and one to the carriage. The carriage was not coupled to the engine, but was pushed before it in ascending, and ran down behind it by its own weight in descending; if, therefore, anything should happen to the engine, the carriage was free, and could be held safely in its place. An ingenious break of another kind was also used in descending. It was a mode of acting on the pistons by a peculiar arrangement of valves in the passages, which allowed the pistons to draw air into the cylinders, and to compress it on the return stroke before it escaped. The degree of this compression could be varied at pleasure by adjusting the escape cocks, and in this way alone a perfect control was exercised over the descent of the train.

In the summer of 1872, the railway carried about 87,000 passengers without any accident or derangement, and it was considered a perfect success. It had cost, including improvements made since its establishment, about £60,000, and it had paid £15 per cent. interest, in addition to a large allowance put aside for a reserve fund.

May 6th, 1873.—T. Hawksley, Esq., President, in the chair. The paper read was a history of "The River Clyde," by Mr. James Deas, M. Inst. C.E., and gave an account of the various works carried out for improving it as a navigable river, and of the modes and cost of dredging and depositing followed in the deepening and widening of it.

It was remarked, that for no river in the kingdom had so much been done "by art and man's device" as for the Clyde above Port-Glasgow; that the river from Glasgow for 12 miles seaward, was nearly as much an artificial navigation as the Suez Canal, and required constant dredging to maintain it; while the ever-increasing size of the vessels of the mercantile navy rendered necessary the constant deepening of the river to enable the navigation to keep pace with the demands of the shipping trade. One hundred years ago the river was fordable even on foot 12 miles below Glasgow.

The engineering works carried out in the Clyde, combined with the mineral resources of the district, had raised Glasgow from an insignificant provincial town, with a population in 1771 of only 35,000, to be the second city in the empire, with a population (including suburbs) of 566,150 according to the census of 1871. The banks of the Clyde were now the seat of the largest ship-building trade in the world. The first steps were taken by the magistrates of Glasgow in 1755, when Smeaton was employed to report as to the improvement of the river. Golborne, of Chester, reported in 1768; James Watt in 1769; Rennie in 1799, 1807 and 1809; Telford in 1806, 1819, 1821 and 1826, and subsequently, engineers of the highest eminence had been consulted. Smeaton, in 1755, found there were twelve different shoals between Glasgow and Renfrew, the two shallowest places being at the present western boundary of the harbour of Glasgow,—where the river was 1 foot 3 inches deep at low water and 3 feet 8 inches deep at high water,—and at a point then within the harbour, where it was 1 foot 6 inches at low water and 3 feet 3 inches at high water. There was now a depth of 14 feet at low water and of 24 feet at high water at each of those places. Ordinary neap tides were then only sensible at Glasgow. Smeaton recommended that a lock and a dam should be constructed 4 miles below Glasgow, in order to secure a depth of 4½ feet of water at all times up to the quay at Glasgow. The lock was to be 18 feet wide, and capable of taking in a vessel of 70 feet in length. Fortunately no lock and dam were constructed, and the first improvement of the navigation was effected by Golborne, who, in 1768, inaugurated the system of contracting the river by the construc-

tion of rubble jetties, and of the removal of the shoals by dredging and ploughing. In 1799, Mr. Rennie recommended the construction of new jetties, and the building of low rubble walls from point to point of the jetties. Two hundred jetties, varying in length from 50 feet to 550 feet, were built. In 1806 Telford recommended the completion of the parallel dykes begun on the recommendation of Rennie, the bringing of the river to a uniform width, and the formation of a towing-path from Renfrew to Glasgow. He disapproved of the quays along the river, and recommended the conversion of a portion of the present bed of the river into a wet dock, and the making of a new channel for the river. This advice was not followed, but as the traffic increased, quays were extended along both sides of the river. From 1807 till the end of 1835, when Walker was appointed engineer, deepening, widening and straightening were continuously carried on. In Walker's first report to the trustees, he stated that there was then a depth of 7 feet to 8 feet at low water at Glasgow, while the lift of a neap tide, which was only sensible in 1755, was 4 feet, and of a spring tide 7 feet or 8 feet, making a depth of 12 feet at high water of a neap tide, and of 15 feet of a spring tide. Scott Russell, in 1837, spent several weeks in carrying out a minute and elaborate series of tidal observations. He found that spring tides rose and fell about 11 feet at Port-Glasgow, and about 7 feet at Glasgow, neap tides rising 6 feet and 4½ feet at those places respectively. The tides now rose about the same at Port-Glasgow, but at Glasgow the spring tides rose 10½ feet, and neap tides 9½ feet. He also found that the time of high water was 83 minutes later at Glasgow than at Port-Glasgow; now it was only 65 minutes later. In 1800 it was 3 hours later at Glasgow than at Port-Glasgow. The time of low water at Glasgow was at present 1 hour and 40 minutes later than at Port-Glasgow. In Glasgow Harbour the tide flows for about 5 hours 40 minutes, and ebbs for about 6 hours 50 minutes; at Port-Glasgow the tide flows for about 6 hours 15 minutes, and ebbs for about 7 hours 2 minutes.

In 1840 was passed an Act, founded on plans prepared by Walker, in which lines, defining both sides of the river when improved, were laid down; and on those lines, with slight modifications at one or two places, to meet the wishes of riparian proprietors, the improvements in the river had been since carried out. Notwithstanding the great changes in the river previous to the passing of that Act, the width of the river above Napier's Dock, in Glasgow Harbour, was then only 168 feet; now it was 410 feet, and vessels of 3,000 tons burthen floated where at that time stood one of the largest cotton mills in the city. Before the river was improved, inundations of the low-lying part of the city of Glasgow were frequent, and engaged the attention of Rennie in 1799 and 1807, and of Walker in 1836. The straightening of the river and the enlargement of its sectional area had put an end to these inundations. In 1830 the greatest draught of vessel that could be navigated safely to Glasgow was 15 feet; in 1839, 17 feet; in 1854, 19 feet; in 1861, 21 feet; and in 1870, 22 feet.

Since 1758 there had been a gradual lowering of the low-water level in the harbour of Glasgow to the extent of nearly 9 feet, 13 inches of this depression having taken place since 1853. The results were not entirely beneficial: quay walls built even as late as twenty years ago were founded too high for the altered level of low water, and the necessity of greater depth of water to suit the class of large vessels now building, had made the walls show a tendency to slip into the river.

Docks were recommended by Telford, Rennie, Clark, Hartley, Logan, Walker,

Bramner and Ure; and Acts for such were obtained in 1840, 1846 and 1870. Until recently the sides of the river afforded sufficient scope for quay extension. The first, and as yet only, dock was opened in 1868. This was a tidal dock having $5\frac{1}{2}$ acres of water-space, and 830 lineal yards of quay. The construction of Stobcross Docks, authorized in 1870, was now begun. These docks would have nearly 30 acres of water-space, 30 acres of quays, 3,100 lineal yards of quays, and would accommodate 1,000,000 tons of shipping per annum at an estimated cost of £1,163,000. The quays in Glasgow Harbour was at present 4,774 lineal yards, exclusive of 830 lineal yards surrounding the dock already referred to; 2,782 yards being on the north, and 1,992 yards on the south side of the river. An additional length of 400 yards on each side of the river was nearly ready for use. The water-space of the portion of the river between the quays was about 70 acres.

There were no public graving docks on the Clyde above Port-Glasgow; but the Clyde trustees were constructing one at Glasgow, 560 feet long, 72 feet in width of entrance, and having 22 feet depth of water at ordinary spring tides. In 1850, a dock of this description, 500 feet in length, was completed for Messrs. Todd and McGregor. At Dumbarton there was one private dock 300 feet long. Port-Glasgow had had a public graving dock since 1762, constructed from the designs of James Watt. Greenock possessed five, Ardrossan one, and Troon two graving docks.

The first Act for the improvement of the River Clyde was passed in 1759. The first steamer, the *Comet*, was built in 1811-12, and by 1818 passenger steamers were numerous on the river. Fly-boats for passengers, propelled by sails and oars, were used before the introduction of steam-boats. Till the year 1818 none of the vessels in the foreign trade came farther up the river than Greenock.

A variety of appliances had been employed in the deepening and widening of the Clyde. The sand banks, when dry at low water, were broken up by common land ploughs, drawn by horses, so that the current might carry the sand away. Another description of plough, much used, consisted of a front plate of iron and two sides of timber; the front plate being armed with prongs when gravel banks were to be operated on. These ploughs were fitted with sling chains at each end, were wrought in pairs by hand capstans, two of which were placed on the river bank, and two on a punt moored in the river on the opposite side of the bank to be removed, and were hauled through the sand bank with their loads, which were removed at low water on to the adjoining land. Harrowing even was had recourse to, a harrow being attached by tackle to the stern of a tug steamer, which set off with the tide, tearing up the bottom as far as requisite; the harrow was then raised, the vessel steamed back against the tide, and the operation was repeated. Dredgers, with small buckets on a ladder, wrought by hand and by horses, succeeded the ploughs and harrows, and in 1824 the first steam-dredger was started. It dredged only to the depth of 10½ feet; whereas now several of the dredgers could work in a depth of nearly 30 feet of water. The cost of dredging varied much, according to the character of the material to be lifted, to the power of the dredger, and to the capacity of the buckets. As the material dredged from the Clyde varied from silt and sewage deposit to the hardest gravel and boulders, completely concreted together, it was evident there must be a corresponding range in the cost per cubic yard of dredging. As an example of good work, it was stated that one of the two most powerful of the trustee's dredgers lifted on each of five consecutive days, in the month of August, 1872, 2,240 cubic yards of material, or about 2,800 tons; the engine

working 9 hours the first day, 9½ hours the second, third, and fifth days, and 9¼ hours on the fourth day; the average strokes of the engine were 33 per minute, the average depth of water the points of the buckets were working at, 20 feet. Dredging was carried on in the Clyde all through the year, 2,400 hours average working time being performed by each dredger per annum. Repairs formed a heavy item in the working expenses of a dredger. An hour each day on the average was consumed in replacing pins, links, and buckets, and nearly every year each dredger was laid up for several weeks undergoing a thorough overhaul.

Occasionally the deposit was removed sufficiently far from the front of the quays to enable the bucket dredgers to work by spooning. The spoon was a large pronged spade with a straight handle about 50 feet long. The spoons were wrought in pairs by hand crab winches, two on the quay and two on a punt moored in the river. One man held the handle of each at the edge of the quay, and one set of three men on the quay, and another set of three on the punt, worked in spoons alternately, from the face outwards and back again for a fresh spoonful.

Boulders, weighing as much as 17½ cwts., were occasionally lifted by the dredgers, but diving bells were constantly employed lifting boulders, some of which weighed upwards of 6 tons. The most important work, however, performed by the diving bells during the last twenty years had been the removal of a bed or dyke of trap rock about four miles below Glasgow. This rock was accidentally discovered in 1852 by one of the first line of steamers started between Glasgow and New York grounding on it. The rock extended over the bed of the river for about 900 feet in length by about 300 feet in breadth. Blasting by gunpowder, fired by an electric battery, had, at a cost of upwards of £16,000, removed the rock over half the channel, so as to give a depth of 14 feet at low water, the other half having an available depth of 8 feet at low water.

Up till the year 1862 the whole of the dredged material was deposited on land at a cost in 1861 of 10·37 pence per cubic yard for depositing alone, exclusive of interest on cost of, or allowance for depreciation of plant. Many acres of alveus thus reclaimed became the property of the riparian proprietors, who now asked from £1,200 to £1,400 per acre for it. In 1860 the trustees introduced steam hopper-barges for the purpose of conveying the material to sea. The result of working for the year ending the 30th of June, 1871, was that the cost of conveying 673,240 cubic yards to, and depositing them in Loch Long, 27 miles from Glasgow, was £15,323 8s. 2d., or 5·46 pence per cubic yard, 1·84 penny of the said rate being 10 per cent. on the value of the barges for interest and depreciation; while for 122,664 cubic yards deposited on land the cost was 16·40 pence per cubic yard, 3·52 pence per cubic yard being 10 per cent. on the value of the punts for interest and depreciation. In the twelve months referred to 904,104 cubic yards, or about 1,130,000 tons, were dredged from the harbour and river, of which 689,560 cubic yards were carried to sea, and 214,544 cubic yards were deposited on land. Of that quantity 345,209 cubic yards were considered deposit, and 558,895 cubic yards new material. During the last twenty-eight years 14,600,000 cubic yards, or upwards of 18,250,000 tons, had been dredged from the river by the Clyde trustees.

The trustees' dredging plant consisted of six steam-dredges, fourteen steam hopper-barges, one steam-tug, three diving bells, two hundred and seventy punts and numerous small boats, one dredger and four hopper-barges having been added in the summer of 1871. The value of the plant was £140,000. In 1867 the trustees, at a cost of £25,000, erected at Dalnair, 8 miles below Glasgow, works for the repair of their

plant, including a patent slip to accommodate their largest dredger. One hundred and forty hands were constantly employed.

From Glasgow to below the mouth of the River Cart, on the north side, and to near Erskine Ferry, on the south side, the river dykes had all been removed, and for that length the river flowed through land now above the level of high water, much of which had been raised to that level by material dredged from the river. The slopes of the banks were 1½ horizontal to 1 vertical, and were covered with whinstone rubble. Until within the last four years when the author became the engineer of the navigation, the stones were hand pitched, at a cost for labour alone of 1s. 2d. per square yard; since then pitching had been discontinued, and the stones left rough as laid on. The slopes stood better, and the waves raised by steamers were more effectually broken. A coating of stones 12 inches in average thickness effectually protected the slopes for months.

The total expenditure of the trustees since 1770 had been £5,594,981 14s. 8d.; of which a sum of £1,390,947 18s. was for interest on borrowed money, £724,453 8s. 3d. for land for the enlargement of the harbour, and £164,838 for land for widening the river below the harbour. The whole expenditure had been paid out of the rates and by money borrowed on the security of these. The total debt of the trust at the 30th June, 1872, amounted to £2,151,557 8s. 3d.

At the monthly ballot the following candidates were duly elected associates:—Messrs. F. H. Ashurst, Stud. Inst. C.E., W. T. Bourne, P. J. Bruff, T. A. Bulkeley, W. L. Crawford, T. C. Ellis, Stud. Inst. C.E., R. G. Elwes, E. Field, A. H. Ford, Lieut.-Col. W. H. Gulliver, R.E., Messrs. S. Harpur, L. Heath, Stud. Inst. C.E., J. Kyle, E. J. Lynch, R. K. MacBride, F. D. Mitchell, C. Prouse, jun., A. E. Schmid, J. S. Sworder, J. L. F. Target, T. Vernon, and O. York.

It was announced that the Council, acting under the provisions of the bye-laws, had transferred Messrs. I. L. Bell, A. S. Hamand, and A. H. Kessner from the class of associates to that of members, and had admitted Messrs. A. E. Baldwin, R. E. Dunstan, and W. Thomas, as students.

May 13, 1873.—T. Hawksley, Esq., President, in the chair.—The paper read, "On the Delta of the Danube, and the Provisional Works executed at the Sulina Mouth," by Sir Charles Augustus Hartley, M. Inst. C.E., was a sequel to a previous communication by the author on March 11, 1872. It described the mutations of the Sulina Bar from 1861 to the present time, and referred to the changes in the sea outline of the Delta during 16 years.

When it was found that the piers, previously described, had maintained an additional depth of water on the bar of from 6ft. to 8ft. for five years after their completion, and that sufficient funds could not be obtained for the improvement of the St. George's branch, the Commission, in 1866, adopted the author's project for the conversion of the Sulina piers into solid structures, and the works were completed in the autumn of 1871. The provisional piers had already been fully described in the author's first paper. They consisted of three rows of piles, the outermost rows being of close piling, on either side of which stones of less than a cubic foot in size were thrown from barges and allowed to take their natural slope up to the water line. During the five years which succeeded, the waves broke down the ridge of stonework to the level of from 3ft. to 4ft. below the water line, and the sea and inner slopes were reduced to 2½ to 1, and 1½ to 1 respectively. The problem was, how best to build in an open sea-way a solid wall 1½ mile long, 10ft. thick, and of nearly the same height, from an irregular foundation of *pierre perdue* to the

level of the fast-rotting timber superstructure. At first the wall was built on a roughly levelled foundation, by lowering masses of unset concrete, within moveable timber dams fitted, in lengths of from 15 to 30ft., to the framework of the piers. The earlier trials were unfortunate, from the proportion of cement mixed with the sand and gravel being insufficient to insure the stability of the blocks under water, and some 35-ton blocks at the pier-head, where the proportion of cement to gravel was only 1 to 4½, succumbed to the force of the winter gales. Ultimately, by the end of the summer of 1868, a length of 2,791ft. of the North Pier was successfully completed, the proportion of cement to the sand and gravel being 1 to 3 in the immersed portion of the wall, and 1 to 6 in the part above water. But although the progress of the works had been hitherto satisfactory, increasing difficulties and expense were met with in the rougher water seaward, and this induced the author, in the spring of 1869, to adopt an alternative plan for consolidating the seaward end of the piers, by carrying up the wall from a foundation on the rock work carefully levelled by hand. Accordingly, a perfectly level bed at the depth of 5ft. over a width of 12ft., on the river side of the sheet piling, was executed by Russian divers for the next 1,247ft. of the North Pier. To afford greater security to the foundations, four 3-inch oak planks were spiked to the open piling which formed the inner row of the provisional piers, the lowest plank being fixed at 7ft. 6in. below the water line. On the foundation thus prepared, blocks, weighing 18 tons each, composed of 1 of cement to 7 of sand and gravel, were lowered from the timber platform above to their destined site, by powerful "goliaths." As each block was 5ft. wide, and the distance between the quintuple rows of piles was 7ft. 6in., the interval between the blocks along the line of works was 2ft. 6in. The blocks were lowered when ten days old, and the spaces between them immediately filled up with newly made concrete, which ultimately consolidated the whole mass. In 1869 the consolidation of the North Pier was carried out to 3,200ft. from the shore, and the South Pier was consolidated for a length of 699ft. on the plan first adopted at the North Pier. In this year steam machinery was erected on shore for the construction of blocks of from 10 tons to 20 tons each, which were afterwards thrown from pontoons at random on the outer slope of the rock-work adjacent to the head of the North Pier, where the waves were found to level down the ordinary *pierre perdue*. In 1870, the remaining length of 1,438ft. of the North Pier was consolidated, and a new iron lighthouse was erected and fitted with a fourth class dioptric light. The consolidation of the South Pier was also completed up to the high-water line in 1870, but its crown-work was not finished till the summer of the following year. The composition of the concrete for different parts of the works was then described, and the quality of the puzzolana and cement.

The total sum expended on the Sulina Piers, of which the north was 5,332ft. long, and the south 3,457ft., amounted to £185,352 on 30th September, 1871, when the works were entirely finished. In 1857, before it was decided to try the effect of temporary works, the lowest engineer's estimate for permanent works was £307,200, and the highest £384,000, so that the tentative works in the first instance, and their subsequent consolidation as described, had been carried out at only one-half the amount estimated in the original projects. Moreover, it was thought that the execution of these projects would occupy nine years, and that by them the depth on the bar would only be increased to 16ft., whereas the present depth of the navigation was 20ft. The piles used in the construction and strengthening of the provisional works were as sound below the water-line as when first driven, and to this the

author attributed the stability as well as the comparatively slight cost of the works as now completed.

When the European Commission of the Danube began its labours in 1856, the entrance to the Sulina branch was a wild open sea-board strewn with wrecks; the depth of channel was rarely more than 9ft. The site, now occupied by wide quays raised high above flood level and more than two miles in length, was entirely covered with water when the sea rose a few inches above the ordinary level; and in the summer of 1857 three months of constant dredging and raking on the bar produced no appreciable effect. On the completion of the provisional piers, in 1861, the depth of water on the bar increased to 17ft., and the Sulina at once took the highest rank among the best commercial harbours in the Black Sea. The subsequent changes in the depth of the bar channel were then detailed, and the formation of sand banks off the pier heads. In June, 1864, the author recommended the Commission to prolong the South Pier, for the following reasons:—

1. Experience had taught that between the piers the channel had kept itself at the normal width of 580ft. and depth of 17ft., by the ordinary action of the river current.

2. It had shown, also, that low summer floods did not produce scour enough to carry away the deposits, formed during low water in the river, beyond the parallelism of the piers.

3. It was also proved that the action of the sea on the bottom during storms swept away the banks deposited in calm weather beyond the North Pier head.

4. The projection of the sandbank, immediately off the South Pier head, had become so considerable that the entrance was only very slightly protected by the North Pier during the prevailing N.N.E. winds, and thus the extra length of 650ft. given to the windward pier, beyond the South Pier, principally to afford this shelter, was no longer of much use.

5. The new sandbank itself was as much in the way of vessels entering and leaving the port as would be a solid work of timber and stone carried from the South Pier head to a point directly opposite the North Pier head.

The most sudden shoaling of the water on the Bar occurred between the 7th and 12th of April, 1866. On the former day the depth of water was 17½ feet, on the latter 14 feet. This sudden deterioration in the depth was accounted for by the wind blowing into the mouth of the river from the east, and across it from the south, at a time when the current was feeble and the river heavily charged with alluvia. On the 25th of the same month, after a strong gale of three days' duration from the N.E., the channel had again deepened to 16½ feet. In 1867 it became necessary to prolong the North Pier landwards, to keep pace with the erosion of the north shore, and to preserve the continuity of the roadway between the pier and the land. In 1869 there were no river floods, and sandbanks again interfered with the entrance, to such an extent, that in July it was resolved to carry out at once the author's recommendation of prolonging the South Pier, so that the overlap of the North Pier, being reduced to 150 feet, the fluvial deposits might be thrown down beyond the head of this pier instead of under its shelter, as heretofore. By November the total length of the South Pier prolongation, viz., 457 feet, was nearly completed, and the beneficial effect became apparent on the recurrence of floods in 1870; as the profitable depth of the channel increased to 19 feet, the depth at the entrance being 22 feet. Finally, after the completion of the works, in 1872, a profitable depth of 20 feet was attained.

With reference to the practical results which followed the deepening of the Sulina Mouth from 9 feet in 1857 to 20 feet in

1872, it was stated that in 1853, 2,490 vessels, measuring 339,457 tons left the port; in 1869, 2,881 vessels, measuring 676,960 tons. The reduction of the number of wrecks had been from an average of 39 in 10,000 leaving the river from 1855 to 1860, to an average of 8 in 10,000 from 1861 to 1869, and of 2 in 10,000 since 1870. The charges on vessels had also been reduced from 2 to 3 francs per quarter for lightering grain across the Bar, in 1857, to 2 francs per register ton for port dues at the present time.

Recent changes along the shores of the Delta were then described. It appeared that the projection of the piers at the Sulina Mouth had had the effect of greatly deepening the sea bottom to the north of the piers between the shore and soundings of 18 feet, and of accelerating the shoaling of the sea bottom to the south of the piers over the same depth. On the other hand, the works had retarded the growth of banks at 24 feet and 30 feet, as their advance eastward to the north and south of the piers, and in front of them, during the ten years ending November, 1871, had only been 44 feet a year, whereas in the twenty-eight years immediately preceding the beginning of the works, the same contour lines had advanced at the rate of 97 feet a year. The author attributed the slower advance of the delta to the circumstance that the great bulk of the silt-bearing waters of the river, on issuing at once into deep water beyond the pier-heads, was carried far to the south-east by the littoral current instead of flowing into the sea, as formerly, with a feeble and constantly decreasing current, by numerous shallow channels. The local growth of the south sandbanks was evidently due to the shelter afforded by the piers from the prevailing winds, which encouraged a more rapid precipitation of solid matter from the turbid waters escaping laterally in a south-west direction after rounding the South Pier head. The erosion to the north of the piers was probably occasioned by the rebound of the sea against the North Pier during heavy north and north-east gales.

Reference was made to the enormous growth of the northern part of the Kilia Delta in recent years, due to the greatly augmented volume of water which had lately flowed to the sea by the Ochakoff branch and New Stamboul Mouth; while a diminution in the advance of the southern extremity of the Kilia Delta was assigned to the impoverishment of the Old Stamboul branch of the river. These changes, from natural causes, in the relative volumes of water delivered to the sea by the Kilia Mouths, were favourable circumstances in considering the problem of the number of years that would probably elapse before the Sulina Mouth would be absorbed in the shallows of the Kilia Delta. Since 1857, owing to the shoaling of the Toulitcha and the St. George's branches, the outflow by the Kilia had increased, so that it now delivered two thirds of the whole volume of the Danube to the sea. Fortunately for the navigation by the Sulina Mouth, the larger portion of the detritus was transported far to sea, and comparatively little went to swell the shallows of the Kilia Mouths. In the last fifteen years the advance of the 30-foot line of soundings had been strictly confined to the sandbanks facing the mouths of the Kilia, Sulina and St. George, and it was shown that an erosive action had been long at work on the shore line and sea bottom to the north and south of the Sulina Mouth.

ZOOLOGICAL SOCIETY OF LONDON. MAY 6TH, 1873.—Professor Newton, F.R.S., vice-president, in the chair.—The secretary read a report on the additions that had been made to the society's menagerie during the months of March and April, 1873, and called particular attention to an example of the Broad Banded Armadillo (*Xenurus uni-*

cinetus), purchased 8th April, which was new to the society's collection; also to a pair of White Necked Cranes (*Grus vipio*) from Japan, purchased 17th April. No examples of this fine species, so far as was known, had previously been brought alive to Europe. Mr. Selater exhibited some photographs of, and made remarks on, a young specimen of the Liberian Hippopotamus (*Hippopotamus liberiensis*) which had recently been received alive by the Zoological Society of Ireland, but had died shortly after its arrival. A communication was read from the Rev. O. P. Cambridge on some new species of Araneidea, chiefly from Oriental Siberia. A communication was read from Mr. G. B. Sowerby, jun., on three species of Land Shells from Madagascar, which he proposed to call *Cyclostoma suffusum*, *C. vexillum*, and *C. perspicuum*, sps. nov. A communication by Messrs. P. L. Selater and O. Salvin contained notes on the range of certain species of American *Limicola* in the southern part of the New World. Two distinct species of Stilts (*Himantopus*) were shown to occur in the Neotropical Region—namely, *H. nigricollis*, Vieill. and *H. brasiliensis*, Brehm. Mr. A. H. Garrod read a memoir on the variations of the carotid arteries of birds, in continuation of the labours of Bauer, Meckel, and Nitzsch upon this subject. Mr. Garrod's observations were based principally upon specimens that died in the society's gardens.

The next meeting of the society for scientific business will be held at the Society's House, in Hanover Square, on Tuesday, the 20th of May, 1873, at half-past eight o'clock, p.m., when the following communications will be made:—1.—Sir Victor Brook, Bart.—On African buffaloes. (Received 18th March, 1873.) 2.—Lord Arthur Russell.—Remarks on varieties of the Carp. 3.—Mr. St. George Mivart.—On *Lepilemur cheirgaleus*, and on the Zoological rank of the *Lemuroidea*. (Received 15th April, 1873.) The following communications remain on hand:—1.—Lord Walsingham.—On the different species of Deer and other ruminants in Oregon and Northern California. (Received 18th April, 1873.) 2.—Messrs. P. L. Selater and O. Salvin.—On some Venezuelan Birds collected by Mr. James M. Spence. (Received 30th April, 1873.) 3.—Mr. R. Swinhoe.—On the White Stork of Japan. (Received 5th May, 1873.)

SOCIETY OF BIBLICAL ARCHÆ- OLOGY.

TUESDAY, MAY 6, 1873.—Dr. Birch, F.S.A., F.R.S.L., President, in the chair. The following candidates were duly elected Members of the Society:—Signor Roger Bouhi, Rome; Isaac Brown Esq.; Mrs. Julia Hussey; the Right Hon. Lord Harrowby, K.G., P.C.M.P. The following papers were then read:—1. "On the Signification and Etymology of the Hebrew noun 'Tirshatha.'" By Richard Cull, F.S.A.—The author objects to the Persian origin of the word, as conjectured by Gesenius, Lee, and Fürst, and shows that the term was not applied to Nehemiah by Artaxerxes, who appointed him to be Pecha or governor of the province, but by the Jews, as their chief or head. Nehemiah was governor, but the book is a record, not of his government of the province, but of his acts as the chief and leader of the Jews, and of reorganizing them into a community. The word "Tirshatha" is shown to be a noun derived from a T-conjugation of the verb *rosh*, to be head, or chief in power and dignity.—2. "On the Olympiads, in connection with the Golden Age of Greece." By W. R. A. Boyle, Esq.—In this paper, after referring to the great battles between Greece and Persia, a rapid sketch was given of the internal divisions and political intrigues between different Grecian States during the Peloponnesian war. One of these arose out of a dispute respecting the payment by the inhabitants of Lepreum to the Eleians, who had the direction of the Olympic Games, of

a talent, as a tribute to the Olympian Jupiter. This the Lepreates refused to pay during the war by reason of the burthens which this imposed upon them, a pretext which the Eleians would not admit. The dispute was referred to the Lacedæmonians; but the Eleians, fearing a hostile decision, were proceeding to enforce payment, when the Lacedæmonians sent a force of a thousand men, who besieged the fort of Phyrcon and garrisoned the city of Lepreum. This was in the second year of the war, just after the Eleians had proclaimed an Olympic truce within their own territory, and were about to proclaim it throughout Greece. Owing to this breach of the established rule, that all military proceedings should at such a time be suspended, the Eleians proceeded no further in proclaiming the Olympic festival which was to follow. This was allowed to drop, and was not held till two years later. It thus happened that one Olympiad extended over six years, instead of four only. This disordered the Olympic reckoning, and thence extended to chronology in general, throwing Sacred History in particular into great confusion. The discovery of the error has furnished a clue by means of which the present erroneous computations may be corrected, the historical accuracy of Holy Scripture may be established, and both profane and Sacred History, from the great Semitic conquest down to the final destruction of Jerusalem by Titus, may be placed upon a firm basis.—3. "On the Sites of Ophir and Taprobane, from Greek and Hindu Authorities." By A. M. Cameron.—After showing on what slight and insufficient grounds the Island of Ceylon was taken for the ancient great maritime kingdom of Taprobane, the author proceeded to consider all that was said of it by the ancient Greek and Roman writers, and showed how in every particular, including even the philological argument from the name, Taprobane was none other than Tipperah or Tæpra-van, a kingdom which has now receded inland and is shorn of most of its territories, but which in early times was washed by the ocean, and was a most powerful maritime kingdom, and which, further, there is reason to believe, included the Island of Ceylon as well as Aurea Chersonesus. The origin, seat, and centre of this kingdom, which sent ambassadors to Rome, and which was renowned all over the ancient world was, and still is, at the north-east extremity of the bay of Bengal. In the same way it was shown how extremely inaccurate were the general determinations of Ophir, of which there is so much said in the Scriptures, and which seems to have been a place of the highest commercial importance to the early Hebrew, Phœnician, and doubtless Egyptian, traders and mariners. It was shown how all the marks of Ophir lead also to the same ancient great maritime kingdom which the Hindus called Tæpara and Tæpra-van and the Greeks Taprobane. These results, with reference to Taprobane and Ophir, both being shown to be one and the same great maritime kingdom, are thus very interesting, and coincide with a shrewd conjecture of the learned Gesenius, who in his notice of Ophir drew attention, among other things, to an ancient place called Uppara, the Greek Hippuros, which, with the usual inaccuracy of ancient maps and the mode of interpreting them, is placed at the southernmost point of the continent of India.—4. "Translation of an Egyptian Hymn to Ammon." By C. W. Goodwin, M.A.—The hymn, now translated for the first time, was taken from a Papyrus of the 19th Dynasty, in the Museum at Boulogne. The language of the poem is of a very sublime description, abounding with archaisms of language which show the hymn to have been founded upon an older sacred poem. The translation was accompanied by an exegetical comment upon the lesser known words and phrases used by the scribe.

BEST EXPLOSIVES FOR TORPEDOES.

At first sight nothing seems more simple than to enclose a given charge of gunpowder or other explosive agent in a water-tight envelope, and to explode it at any moderate depth of immersion. Submarine charges were successfully exploded for warlike purposes three hundred years ago. Systems for their application to naval war were developed at the beginning of this century. But it was not until quite recently that investigations, more or less searching, have been made by America, Holland, Austria, France, Germany, Russia, and this country into the principles which determine and govern such explosions. Until within the last few years the modes of igniting submarine charges were crude and uncertain in the extreme, whilst the widest divergence of opinion was entertained by the most intelligent and experienced officers as to the influence exerted upon the destructive results by the interposition of given thicknesses of water between the explosive agent and the bottom of the ship attacked. There were, until quite recently, no exact data for regulating the amount, the nature, the immersion, or the horizontal distance of the charge. Still less, if possible, was known as to the thickness of the enclosing case best adapted to develop the full explosive force of given charges. It has now been ascertained that each varying amount of gunpowder produces its maximum destructive result at an ascertainable depth of immersion and enclosed in a vessel of a particular strength. The lateral distance at which such charges would be destructive when suitably immersed has also been approximately determined. The vertical distance beneath a ship at which explosion may be effected appears, in the case of large charges, to be a matter of little practical consequence. Comparative experiments conducted with small quantities of gunpowder are liable to be vitiated by extraneous circumstances of a minute character, which are apt to escape detection, and need verification by a much wider observation of large explosions than has yet been attempted. Enough, however, has been done to show that gun-cotton, litho-fracteur, dynamite, and such other preparations of nitro-glycerine as may be steadfast in character, have special advantages for naval torpedoes. When exploded by detonation, the thickness and even the tightness of the envelope is of little consequence; whereas the full effect of gunpowder cannot be secured without the employment of very strong and heavy water-tight cases; whilst at least three times the weight of charge is necessary to ensure the same destructive range when gunpowder is the explosive agent.—*Naval Science.*

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